THURSDAY, APRIL 27, 1882

## CHARLES DARWIN

VERY few, even among those who have taken the keenest interest in the progress of the revolution in natural knowledge set afoot by the publication of the "Origin of Species"; and who have watched, not without astonishment, the rapid and complete change which has been effected both inside and outside the boundaries of the scientific world in the attitude of men's minds towards the doctrines which are expounded in that great work, can have been prepared for the extraordinary manifestation of affectionate regard for the man, and of profound reverence for the philosopher, which followed the announcement, on Thursday last, of the death of Mr. Darwin.

Not only in these islands, where so many have felt the fascination of personal contact with an intellect which had no superior, and with a character which was even nobler than the intellect; but, in all parts of the civilised world, it would seem that those whose business it is to feel the pulse of nations and to know what interests the masses of mankind, were well aware that thousands of their readers would think the world the poorer for Darwin's death, and would dwell with eager interest upon every incident of his history. In France, in Germany, in Austro-Hungary, in Italy, in the United States, writers of all shades of opinion, for once unanimous, have paid a willing tribute to the worth of our great countryman, ignored in life by the official representatives of the kingdom, but laid in death among his peers in Westminster Abbey by the will of the intelligence of the nation.

It is not for us to allude to the sacred sorrows of the bereaved home at Down; but it is no secret that, outside that domestic group, there are many to whom Mr. Darwin's death is a wholly irreparable loss. And this not merely because of his wonderfully genial, simple, and generous nature; his cheerful and animated conversation, and the infinite variety and accuracy of his information; but because the more one knew of him, the more he seemed the incorporated ideal of a man of science. Acute as were his reasoning powers, vast as was his knowledge, marvellous as was his tenacious industry, under physical difficulties which would have converted nine men out of ten into aimless invalids; it was not these qualities, great as they were, which impressed those who were admitted to his intimacy with involuntary veneration, but a certain intense and almost passionate honesty by which all his thoughts and actions were irradiated, as by a central fire.

It was this rarest and greatest of endowments which kept his vivid imagination and great speculative powers within due bounds; which compelled him to undertake the prodigious labours of original investigation and of reading, upon which his published works are based; which made him accept criticisms and suggestions from any body and every body, not only without impatience, but with expressions of gratitude sometimes almost comically in excess of their value; which led him to allow neither himself nor others to be deceived by phrases, and to spare neither time nor pains in order to obtain clear and distinct ideas upon every topic with which he occupied himself.

One could not converse with Darwin without being reminded of Socrates. There was the same desire to find some one wiser than himself; the same belief in the sovereignty of reason; the same ready humour; the same sympathetic interest in all the ways and works of men. But instead of turning away from the problems of nature as hopelessly insoluble, our modern philosopher devoted his whole life to attacking them in the spirit of Heraclitus and of Democritus, with results which are as the substance of which their speculations were anticipatory shadows.

The due appreciation or even enumeration of these results is neither practicable nor desirable at this moment. There is a time for all things—a time for glorying in our ever-extending conquests over the realm of nature, and a time for mourning over the heroes who have led us to victory.

None have fought better, and none have been more fortunate than Charles Darwin. He found a great truth, trodden under foot, reviled by bigots, and ridiculed by all the world; he lived long enough to see it, chiefly by his own efforts, irrefragably established in science, inseparably incorporated with the common thoughts of men, and only hated and feared by those who would revile, but dare not. What shall a man desire more than this? Once more the image of Socrates rises unbidden, and the noble peroration of the "Apology" rings in our ears as if it were Charles Darwin's farewell:—

"The hour of departure has arrived, and we go our ways—I to die and you to live. Which is the better, God only knows."

T. H. HUXLEY

## PROF. WIESNER ON "THE POWER OF MOVEMENT IN PLANTS"[1]

*Das Bewegungsvermögen der Pflanzen: eine kritische Studie über das gleichnamige Werk, von Charles Darwin, nebst neuen Untersuchungen.* Von Julius Wiesner. 8vo, pp. 212. Three Woodcuts. (Wien: Hölder, 1881.)

*LIGHT as a Stimulus.*—In "The Power of Movement" (p. 458) we observed the heliotropic curvature of a number of seedlings placed at 2, 4, 8, 12, 16, and 20 feet from a lateral light, and we came to the conclusion from inspection that the difference in heliotropic effect was not proportional to the intensity of light which the different sets of plants received. We think that this fact shows that light acts as a stimulus in causing heliotropism; if it acted in a simple physical manner the effects would bear some closer relation to the intensities of the causes.

Wiesner criticises this conclusion, and says (p. 78) that the fact is capable of a simple physical explanation. Wiesner has discovered that when plants are subjected to extremely bright light, they do not bend so much as when the light is slightly weaker (optimum for heliotropism); then as the light becomes weaker still, the heliotropic curvature again diminishes. This fact is supposed to be explicable by assuming the existence of certain negatively heliotropic elements. As far as I understand him, Wiesner does not allude to this question when he speaks of there being a simple explanation of the relationship between

[1] Continued from p. 582

intensity of light and amount of curvature; and an explanation which requires so large an assumption cannot be considered a simple one. I shall therefore at present neglect the existence of the optimum, and consider the heliotropic curvatures produced by degrees of light all below the optimum. Here we see plainly enough that the intensity of the light is by no means proportional to the curvature.

Now Wiesner's explanation is that "the difference of illumination on the lighted and shaded sides, which causes the unequal growth leading to heliotropism is not proportional to the intensity of the light." This statement is in opposition to the laws of Optics. If J is the intensity of light per unit of surface, illuminating the light side, then the amount of light absorbed in passing through the plant is a certain proportion of J (call it A J), therefore the illumination on the darker side is $J - AJ = J(1-A)$; and the difference between the illuminations on the two sides is A J, that is to say, the difference is proportional to the intensity of the light. [The proportion between the two intensities is $\frac{J}{J(1-A)} = \frac{1}{1-A}$, which is constant.]

Wiesner might connect the heliotropic facts with his observations on the amounts of longitudinal growth under different intensities of light (Monograph, Part ii. p. 12 and following pages); but this is only pushing the difficulty one step further back. The fact remains that the way in which growth is checked by light does not resemble the effect of light on photographic paper, but is more like the effect of light on sensitive animal tissues.[1]

Sachs and his pupil Müller Thurgau made known long ago the important phenomena of "Nachwirkung," or *after-effect*. If a plant is laterally illuminated for a certain time and then placed in the dark, the curvature will be continued in the same direction as though light was still acting on it. Or if, instead of being darkened, it is simply turned round, so that the direction of the light is reversed, the plant will go on curving in the direction in which it has begun to do so, in spite of the light now illuminating the opposite side. This phenomena we compared with the after effect of light on the retina. But Wiesner will not allow this comparison, chiefly because he finds an analogy between the after effect of light on plants and the photo-chemical induction of Bunsen and Roscoe (Wiesner's Monograph, i. p. 66). But we may just as well say that the effect of light on the *retina* is comparable to photo-chemical induction. We should then be able not only to say that light may in some respects act in a similar way on plants and animals, but (thanks to Wiesner) we should be able to form a theory as to why this is so.

In the "Power of Movement" we recorded our belief that plants are sensitive to the successive contrast of light and darkness, and this seems to us another point of resemblance between the sensitiveness of plants and animals. Thus, plants which have been exposed to the daylight did not become so quickly heliotropic as others, which had been kept in darkness. Again, consistently with this view, we attributed the striking effects of intermittent light to the increased sensitiveness of plants kept in the dark.

With respect to the effect of intermittent light, Wiesner states that the heliotropism produced by intermittent light is not *greater* than that due to constant illumination. The fact that so much heliotropic curvature is produced, is supposed to be due to the after-effect of the periods of illumination being continued through the periods of darkness, and thus producing an effect equivalent to continuous illumination. This naturally occurred to us, and it may possibly be the correct explanation.

Our statement that plants are more sensitive to light if they have been kept in the dark, Wiesner considers to be well known to be true, in the case at least of etiolated plants. He explains it by the increased capability for growth which is produced by darkness. On the other hand, he quotes an experiment from his "Monograph" to show that a plant subjected to equal illumination on all sides is rendered more sensitive heliotropically than a plant grown in the dark. This fact he considers as quite destructive of our view on the effect of contrast. He explains the result as follows.

The turgescence of the cells of an organ offer a certain resistance to its curvature, and therefore anything that slightly diminishes the turgescence increases the power of bending heliotropically; and as bright illumination diminishes turgescence, it may be expected to increase the heliotropic sensitiveness. This is such a contradiction to his explanation of our results and to other statements of his, that I should be inclined to think that I have misunderstood him. But we have on the same page (p. 83) our observations explained as the result of the increased "capacity for growth" caused by darkness, while his own observations are explained by diminished turgescence, which must imply diminished capability for growth as its chief result. If Wiesner explains his own observations correctly, he cannot explain ours, and therefore his criticism is deprived of all force.[1]

*Geotropism—Sensitiveness of Root-tips to Gravitation.*—If the extreme tip of a root (1 to 1·5 mm.) be cut off, the root will continue to grow vigorously, but it ceases, or almost ceases, to be geotropic.[2] We concluded that when a root is placed horizontally, the force of gravity acts on the tip, and a stimulus is transmitted to the growing part of the root, causing it to bend down. And that accordingly when the root-tip is destroyed the root is incapable of receiving the stimulus of gravitation. Wiesner differs entirely from this point of view, and believes that the diminished geotropism of the pointless roots is simply due to their diminished activity of growth due to the injury. I have elsewhere treated this question experimentally, and have been able to show that if the tip is not cut off roots may be very severely injured in other ways, so that the growth is greatly retarded, and that they are nevertheless capable of geotropic curvature. I have thus shown that Wiesner's explanation of the facts cannot be the right one, since mere retardation of growth is not sufficient to account for loss of geotropism.

*Sensitiveness of Root-tips.*—In "The Power of Movements" we showed that the tips of roots are stimulated in a peculiar manner by the continued contact of small squares of cardboard cemented to one side of the extreme tip of the root. It was found that the root curved

[1] Of course no one denies that stimulation ultimately depends on the physical properties of the sensitive tissue.

[1] It should also be observed that Wiesner's experiments were made with etiolated plants, which was not the case with ours. It appears (Monograph, p. 8) that in *V. Faba* and *Soja hispida* no increase of heliotropic sensibility was produced by illumination.

[2] "Power of Movement," Chap. x. The original experiment on this point is due to Ciesielski.

away from the side on which the card was fastened, so that in some cases the root made complete loops by its continued curved growth. We believe that the tips of roots are sensitive to contact, and that when a root meets with an obstacle in its way the pressure on one side of the tip causes the growing part of the root to grow more rapidly on the side of the obstacle, and thus curve away from it. It is conceivable that a root should curve away from an obstacle, owing to the forcible bending of the root, just as any other ductile object would give way when forced against a fixed object It was from observing roots bending away from fixed obstacles placed in the way of their growth that we were led to suspect that the curvature was not due to forcible bending, but to a special kind of curvature, due to stimulus transmitted from the sensitive tip.

Wiesner confirms our facts, but differs entirely in his interpretation of them. His explanation rests on certain facts observed by us, namely, that if the extreme apex of a root be wounded on one side by an oblique cut with a razor, or by a touch with lunar caustic, the same curvature occurs as when pieces of card are attached. Wiesner believes that the spirits of wine contained in the shellac varnish which was used in many of the experiments to fasten on the cards, injures the root on one side, and that this accounts for the curvature which we ascribe to contact. But Wiesner's criticism is incomplete on this point. He takes no notice of the experiments in which we used thick gum, instead of shellac varnish, for attaching the pieces of card to the tips of the roots. It is difficult to believe that gum injures the roots, since gum by itself produces no effect; and it seemed pretty clear that it was the card, and not the gum, which acted, for when, as often occurred, the gum absorbed water and swelled up so that the card was separated from the root, no effect was produced. Nor does Wiesner mention our experiment in which the shellac varnish was not attached directly, but to a small piece of gold-beater's skin applied to the root.

If Wiesner's view is correct, then since the thick shellac varnish which we used hardens on the surface in a few minutes, it is clear that the injury to the root must take place in this short period. This however has not been shown to be the case.

Wiesner makes a great point of an experiment in which he causes small pieces of wood (p. 144) and sand to adhere, by pressing them against one side of the root-tip without using shellac: under these circumstances he says that no curvature took place. This experiment does not seem to me so important as Wiesner would have us believe, but for reasons given in the next paragraph I defer further discussion of the whole question.

A few words must be given to some of Wiesner's other experiments on this subject. He caused roots to grow against various more or less yielding objects in such a way that he could estimate the pressure against the root-tip, and found that the root did not bend from the touching obstacle till the pressure is sufficient to cause forcible bending. Here Wiesner's experiments seem not to be quite conclusive, and I have begun to make experiments which I hope will prove to be crucial. But I have been obliged to stop, because of the curious want of sensitiveness in the tip of the root which has occurred in a large proportion of the beans tried. I have repeated the experiment of fastening on pieces of sand-paper with shellac to one side of the root-tip, and in the large majority of cases no curvature ensued. I have no means of knowing what the meaning of this failure may be (I am inclined to believe it is owing to the experiments being made in the winter), but it is clearly useless to pursue the experiments with such abnormal material.

Wiesner seems to be in doubt whether or not the curvature of the root away from the injured side implies that a stimulus travels from the sensitive tip to the growing part of the root, whether, in fact, the injury to the root acts as a stimulus. The alternative proposed by Wiesner (p. 145), and which he thinks more probable, is that in consequence of injury, "the uninjured part of the root gets into a state which directly increases its capability of growth without any stimulus coming into action." Wiesner's conception of stimulus ("Reiz") is not quite easy to understand, thus, for instance his definition of "Reiz" ("Elemente der Anat. und Physiol. der Pflanzen," 1881, pp. 249, 250) is an "influence whose mechanical efficiency (Leisting) is out of proportion to the resulting mechanical effect. A stimulus in this sense does not directly cause the movement, it merely releases the efficient forces, just as the pressure of a finger on the trigger of a gun produces the explosion indeed, but stands in no relation to the force with which the ball is driven through the barrel." In accordance with this definition he describes ("Anatomie," p. 253) the nocturnal (nyctitropic) movements of the leaves of Robinia as "a phenomenon of stimulation (Reiz-erscheinung) depending on differences of Turgor." Again, in his present work ("Bewegungsvermögen") he gives (p. 25) a definition of "Reiz," which is essentially the same as that already given. He adds, however, the characteristic of transmission to his definition:—"Every irritable part has the power of transmitting the stimulus to neighbouring parts which are also usually irritable." He goes on to say that the sleep-movements of leaves do not realise the characteristics of a Reiz-Erscheinung, thus contradicting what he says in his other work.[1] Whether we take the first or the second definition, it seems surprising that Wiesner should doubt that the curvature of a root when its tip is injured is a phenomenon of stimulation. If it were, as Wiesner is inclined to believe, the direct mechanical effect of the injury, the result would be curious; for if injuring one side of the root causes increased growth on the same side as the injury, it is clear that injuring both sides symmetrically ought to increase the whole growth of the organ. And accordingly when the tip is cut off by a section perpendicular to the axis of the root, its growth ought to be accelerated; which would be directly contrary to the results of Wiesner's experiments on this point.

Symmetrical injury to the tip looked at from our point of view could not of course be expected to lead to consequences of this sort.

The next chapter in Wiesner's book begins with the question of "spontaneous" nutations, and under this heading occur the hook-like curvatures of the ends of shoots of Ampelopsis. This curvature Wiesner considers

[1] It seems to me inconceivable that a stimulus should act indirectly by releasing potential energy, as in the case of discharging a gun, unless some kind of transmission of the stimulus takes place; and if this is so, Wiesner's two definitions are identical.

to be due to the weight of the end of the shoot; we ascribed it to epinasty, because on horizontal and inclined branches the hooked tip does not necessarily point vertically downwards, but is often horizontal, or points upwards (Power of Movement, p. 272). Wiesner on the other hand states that all the ends of shoots observed by him at the season when the Ampelopsis is growing vigorously pointed downwards; this fact would gain in value if it were stated that the observations included horizontal branches. On the same page he remarks that the downward directed shoot often goes far beyond the vertical, and this, as well as the vertical position seen in other cases, is explained by "Zugwachsthum" (*i.e.* "growth produced by strain"), due to the weight of the shoot. How this can possibly be the case is not explained.

*Diaheliotropism.*—The power possessed by many leaves of placing themselves at right angles to the direction of incident light was called *Transversal Heliotropismus* by A. B. Frank; we have called it diaheliotropism, partly for the sake of convenience and of uniformity in nomenclature, and partly because our view does not exactly coincide with Frank's. Wiesner asserts positively that diaheliotropism does not exist, and that all the phenomena can be explained as the result of the balance of ordinary forces, positive and negative, heliotropism, positive and negative, geotropism, epinasty, hyponasty, weight, &c.

The main features of Wiesner's explanation are as follows:—We are supposed to have a vertical bud whose leaves are bending epinastically down towards the horizontal position, which they ultimately assume when the light comes vertically from above. In this stage of growth before the position of the leaves is determined by that of the light, Wiesner speaks of the possibility of a balance being struck between epinasty and apogeotropism. But Frank (*Bot. Zeitung*, 1873, p. 22) has long ago shown the impossibility of a balance being struck between a constant force like epinasty, and a force (and this would apply to apogeotropism) which varies with the position of the organ with regard to the horizon.

To continue Wiesner's explanation: when the plant is exposed to a zenith illumination, the leaves bend downwards owing to apheliotropism, and if truly apheliotropic, would continue to bend till they pointed vertically downwards. But Wiesner believes that the light, besides causing apheliotropic movement in the leaves, has the power of checking their apogeotropism. If therefore the leaves in moving downwards go beyond the horizontal position, they become obliquely illuminated, and accordingly the light being weaker, the inhibition of apogeotropism is lessened, and the leaves rise up. What occurs if the leaves, in this upward movement, go beyond the horizontal is not explained, for in this case also the apogeotropism would be diminished. To explain this it would be necessary to make more assumptions as to the variations in apheliotropism due to the varying obliquity of light, and the variations in apogeotropism due to varying positions of the leaves with regard to the horizon; and no such assumptions are made by Wiesner. The faultiness of Wiesner's explanation is made clear by the following example. Let us assume that Wiesner's explanation holds good for zenith illumination, and suppose that a seedling dicotyledonous plant under these conditions is suddenly subjected to oblique light. Then both that cotyledon which is on the illuminated side, and the one on the shaded side will be obliquely illuminated, therefore, according to Wiesner, the apogeotropism of both cotyledons will be increased, and both should rise up; but what really happens is that one falls and the other rises. This seems inexplicable, unless we suppose that the apheliotropism of the leaves differs according as the light falls, as shown by arrow No. 1 or No. 2 in Fig. 2.

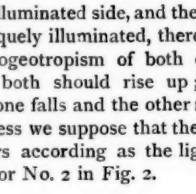


FIG. 2.—Diagram representing a seedling dicotyledon exposed to oblique light. *h*, the hypocotyl, or stalk; *c*, *c*, the cotyledons; the arrows represent the direction of the light.

Wiesner's explanations are also shown to be untenable, at least in some cases, by my observations "On the Power possessed by Leaves of placing themselves at Right Angles to the Direction of Incident Light" (*Journal* of Linn. Soc., vol. xviii., 1881). I have there shown that certain plants are able to place their leaves at right angles to incident light when removed from the action of apogeotropism. These experiments are not discussed by Wiesner, and would seem to be inexplicable from his point of view. When engaged in this work on diaheliotropism I was struck with the impropriety of considering as heliotropic all movements towards a source of light, or all movements away from it as negatively heliotropic. Thus the leaves of *Ranunculus ficaria* move either towards or from the light (independently of gravitation), according as either of these movements is required to place the leaves at right angles to the direction of the incident light. And it is obviously impossible to call the leaves both negatively *and* positively heliotropic. It is far more rational to call them diaheliotropic; and there is no more objection to the use of this term than there is to the terms heliotropism or apheliotropism; all such terms are confessions of ignorance, and none of them exclude further research into the phenomena to which they are applied.

*Diageotropism.*—As a diaheliotropic organ is one which possesses the power of placing itself at right angles to the direction of incident light, so a diageotropic organ is one which possesses the power of growing at right angles to the line of gravitation. Thus certain underground stems possess the power of growing horizontally beneath the surface, instead of vertically upwards, like most stems.

In Wiesner's few remarks on this subject, he completely ignores Elfving's remarkable paper on horizontally-growing rhizomes, which we especially referred to, and which is by far the most striking evidence which we possess in favour of the existence of diageotropism.

*Hydrotropism.*—Roots have the power of bending towards a wet surface, and we have shown, that when the tip of the root is covered with a layer of grease, the root does not usually bend towards the wet surface, from which we inferred that the sensitiveness to moisture resides in the tip. Wiesner believes that the treatment to which the tip of the root is subjected, lessens the power

of growth of the root, and that the loss of hydrotropism is a consequence of the less vigorous growth in the root; this is practically the same criticism as that which Wiesner has applied to our views on geotropism; namely, that the lessened rate of growth caused by the injury to the *punctum vegetationis* interferes with the power of geotropic curvature.

Wiesner has, however, himself observed the fact that the *less* turgescent roots are those which seem to exhibit hydrotropism best, and as want of turgescence would certainly interfere with normal growth, fully as much as the grease on the tips of the roots, Wiesner's criticism seems to be considerably weakened.

In a notice of the present extent, it would be impossible to notice all Wiesner's experiments and arguments, many of which possess much interest. To do so, would require a whole volume such as Wiesner has devoted to the subject, and to which I must refer those who wish to be better acquainted with his views. Finally, I would ask those who do so, not to forget to refer to "The Power of Movement in Plants," for it is only by studying the two books together, that an adequate opinion on the questions at issue can be formed. FRANCIS DARWIN

## OUR BOOK SHELF

*Catalogue of the Batrachia, Salientia and Ecaudata in the Collection of the British Museum.* By George Albert Boulenger. (London: Printed by Order of the Trustees, 1882.)

THIS volume is a proof of the steady though rapid progress which our great Natural History Collection is making, and is a token as well that under the present keeper of the Zoological Department, the stores of specimens will be made fully available for scientific reference. To the working zoologist there can be no more acceptable gift than such carefully compiled catalogues, and by the publication of such the collection itself not only indirectly but even directly benefits, for an interest is awakened in the objects described, and thereby the stream of donations begins to flow. The first edition of this Catalogue, published in 1858, contained the description of some 283 species, and the collection consisted of some 1691 specimens. The present edition contains the description of 800 species, of which the British Museum possesses 522, represented by some 4692 specimens. The first edition, by Dr. Günther, without doubt gave a great impulse to the study of the tailless Batrachians, and as a result it is now out of date. For the present edition Dr. Günther has been fortunate in securing the services of Mr. Boulenger, the assistant naturalist in the Royal Museum of Belgium, and exceedingly well has the latter accomplished his task. The classification adopted is based on that of Mr. E. D. Cope, somewhat modified, and biologists in general will be pleased to know that this classification seems to harmonise not only with the natural affinities of the genera, but with all that is known of the geographical distribution, development, and physiology of the group. The only serious objection urged against it is the supposed difficulty of ascertaining on the recent specimens the osteological characters, without sacrificing one or more specimens; but, as Mr. Boulenger asserts, it requires only a moderate skill and two or three clean incisions to reveal all the required secrets of the structure of the vertebræ.

One important feature in this catalogue is that we find in it an account of all the known species of the group, so that it to a great extent possesses the merit of being a monograph, and it thus indicates the species which are wanting in the National collection. There is also a very considerable beginning made in the descriptions of the larval forms, and sometimes these are figured, the collecting of these forms we trust may receive a fresh stimulus from the publication of this work.

Mr. Boulenger well merits the confidence with which Dr. Günther writes that "zoologists will thankfully acknowledge the industry and ability with which the author has performed his difficult task."

It only remains to add that this catalogue is illustrated with numerous woodcut illustrations, and with thirty lithographic plates.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

### On the Conservation of Solar Energy

WITH your permission I should like to offer a few remarks upon the interesting paper of Dr. C. William Siemens on the "Conservation of Solar Energy," published in NATURE (vol. xxv. p. 440). The main hypothesis upon which that paper is based, that of a fan-like action of the sun, is not improbable; nor are the consequences drawn illogical, if we could reasonably imagine space to be occupied by such condensed molecules as he supposes. That space is everywhere occupied by matter, there is no just reason to doubt. The hypothesis of an ether, specifically distinct from matter, is a gratuitous assumption, and one of the last surviving relics of eighteenth century science. Unless it can be proved that highly disintegrated matter is positively incapable of conveying light vibrations, there is no warrant for assigning this duty to a distinct form of substance. But that matter exists in outer space in the same conditions as in the planetary atmospheres is certainly improbable. Its duty as a conveyer of radiant vibrations seems to require a far greater tensity, and its disintegration is probably extreme.

If we assume, then, that matter exists throughout the universe, here as condensed spheres, there as highly rarefied substance, with the atmospheric envelopes of the spheres gradually shading off into the excessively rare matter of mid space; another hypothesis may be deduced, somewhat different to that offered by Dr. Siemens. The views which I desire to present have been already published, but they seem worthy of repetition in connection with his solar theory.

On the Nebular hypothesis, the matter of the sun was once disseminated through space. Gravitative attraction has, therefore, had a double effect. The greater portion of this matter is now drawn together into a contracted mass. The remaining portion yet occupies outer space, in a far more rarefied condition than the original. But an important consequence attends the condensation and rarefaction of gases. This is, that condensed gases become heated, rarefied gases cooled, and this without the aid of heat exchange with outer material. In the one case a portion of the absolute heat of the gas, formerly latent, becomes sensible; in the other a portion of the sensible heat becomes latent. If originally the absolute heat contents and the temperatures were alike equal, condensation and rarefaction would not, of themselves, change the heat contents, but they would change the temperatures. In condensation, the latent heat is reduced, the sensible heat increased, and the temperature rises. In rarefaction the opposite effect is produced, and the temperature falls.

This consideration applies as well to the problem of the condensation of nebulous as of terrestrial gases. The effect of contraction of nebulous gas into a dense sphere, must be a considerable rise in temperature if there be no diminution of absolute heat contents. The effect of rarefaction of the remaining matter of space must be a decrease in temperature. Thus if radiant outflow of heat from the sun had been prevented during its condensation, the eventual result must have been that the sun and the matter of outer space would have continued equal, mass for mass, in absolute heat contents, and yet have become immensely different in temperature.

And from this must have come another interesting result,

namely, that their degree of disintegration would continue the same. There could be no more chemical combination in the sun, if thus retaining all its heat, than in the rare matter of space. For chemical condensation to take place the heat contents must be reduced. An equal degree of absolute heat signifies an equal motive vigour of particles, and it is this motive vigour which enables them to resist chemical attraction. It may be supposed, however, that in dense matter the chemical attraction would be more effective from its increased energy through contiguity. Yet this is an erroneous idea; there is no real greater contiguity between the particles of dense than of rare matter. In both cases, the particles are brought incessantly into absolute contact through their vibrations. The number of contacts of dense as compared with rare matter may be millions to one, but that can have no effect upon the result. If the chemical vigour be stronger than the vibratory vigour it will overcome it in the contact; if it be weaker it will fail to overcome it, and a more frequent repetition of contacts cannot materially aid this result.

Thus all substances of equal absolute heat must be equal in degree of chemical integration, whatever their degrees of tensity or condensation. But the assumed equality of absolute heat cannot continue between dense and rare gases. The sensible heat of the dense gas tends to radiate out into the chilled rare gas. A constant and vigorous effort to equalise temperatures takes place. With every outflow of radiant heat from a sphere into space the absolute heat of the particles of the sphere decreases, that of the rare matter of space increases. The absolute heat contents grow more unequal with every step towards equalisation of temperatures. Consequently a variation in chemical condition arises. The loss of heat by the sun, for instance, reduces the vibratory resistance to attraction, and with every such loss chemical molecules of greater complexity are formed. This heat is radiated into space. Probably some portion of this radiant heat is arrested and becomes local heat in the matter of space. If so the heat vigour of this matter increases, disintegration must ensue, and the increasing chemical condensation in the sun must be matched by an increasing chemical disintegration in outer matter.

During the myriad years of solar condensation, this process of heat-outflow has been continuous, so that now, despite its great excess of temperature, the absolute heat of solar matter must be far below that of an equal mass of the matter of outer space. Can the heat thus lost by the sun be recovered? If it could, the solar heat emissions might continue indefinitely. Dr. Siemens' hypothesis offers a method of recovery. If the matter of outer space is drawn into the solar atmosphere by such a polar inflow as he supposes, and subjected to the vigorous condensing influence of solar gravity, its volume must be very greatly decreased, and much of its latent heat become sensible. And as its absolute heat-contents are far in excess of those of solar matter, the result of such condensation must be a high degree of temperature, and a continual replacement of the radiated heat of the sun. Without any chemical integration taking place in this inflowing matter, the solar temperature may be kept up by its mere condensation, and by rendering available its great excess of absolute heat. With chemical integration, and the consequent much greater condensation, of course the heat-yielding effect must be much more considerable.

This inflow of outer matter to the sun is, in Dr. Siemens' hypothesis, rendered possible by a continuous outflow of solar matter to outer space, thus carrying substance of low heat energy to be mingled with the rarefied exterior matter, whose high heat energy is thereby somewhat reduced. Such a process, however, has in it something of the flavour of perpetual motion. The sun is giving and taking, and its receptions may be equal to its emissions. It would thus constitute a machine yielding power to, and regaining power—to be again yielded—from the same substance. Yet there is another element in the case, which relieves it of this suspicious perpetual motion flavour. If the sun is constantly flinging off rare matter at a tangent from its upper atmosphere, there must be a reaction upon the rotatory energy of the solar sphere. It must be gradually losing its energy of rotation, with extreme slowness, of course, since the weight thrown off is very slight, but in time the effect cannot but become a marked one, and perhaps this loss of solar energy may be the ultimate source of the new heat obtained by such a process. We may conceive of a like process taking place, to a less marked extent, in the large and rapidly rotating planets, such as Jupiter.

CHARLES MORRIS

Philadelphia, U.S.

UNDER this title Dr. C. W. Siemens, on March 2, presented to the Royal Society a paper, which is published in NATURE, vol. xxv. p. 440. Therein, after noticing the hypotheses proposed by Meyer, Helmholtz, and Sir William Thomson, to explain the maintenance of solar heat, he endeavours to show how the energy apparently lost by radiation from the sun into space, may be gathered up and restored to the centre of our system. This he conceives to be effected through the intervention of attenuated matter diffused throughout space, which is the recipient of the radiated energy, and is continuously absorbed and again reflected by the centrifugal action of the sun itself. The matter diffused through space he supposes to include oxygen and nitrogen, hydrogen, aqueous vapour, and carbon compounds, besides solid materials which are probably exhalations from the sun, and constitute the so-called cosmic dust.[1]

In support of this view of an interstellary nature Dr. Siemens cites Grove and Mattieu Williams, among others, but does not seem aware that its agency in gathering up and restoring to the sun its lost radiant energy, has been maintained by these writers. Sir William Grove, in his address as President of the British Association in 1866, attempted to find in this interstellar matter (whose nature and relations to our atmosphere he had already considered in 1843, in his celebrated essay on "The Correlation of Forces"), a source of solar heat, inasmuch as the sun "may condense gaseous matters as it travels in space, and so heat may be produced." This same view suggests the title of "The Fuel of the Sun," by Mattieu Williams, a book published in 1860, the argument of which, as briefly resumed by me in an essay on "The Chemical and Geological Relations of the Atmosphere," in the *American Journal of Science* for May, 1880, is as follows:—

"The solar heat, according to Williams, is maintained by the sun's condensation of the attenuated matter everywhere encountered by that body in its motion through interstellar space. The irregular movements impressed upon the sun by the varying attractions of the planets, stirring up and intermingling the different strata of the solar atmosphere, and producing the great perturbations therein, of which the telescope affords evidence, are, in his hypothesis, the efficient agents in the process. The diffused matter or ether, which is the recipient of the heat-radiations of the universe, is therebydrawn into the depths of the solar mass; repelling thence the previously condensed and thermally-exhausted ether, it becomes compressed and gives up its heat, to be, in turn, itself driven out in a rarefied and cooled state, and to absorb a fresh supply of heat, which he supposes to be, in this way, taken up by the ether, and again concentrated and redistributed by the suns of the universe."

The astronomer must judge between the different views of the mechanism of what may be called the process of solar respiration in this hypothesis, as put forward by Siemens and Williams respectively. We may call attention in this connection to Newton's "Principia," book iii., proposition 12.

The views of Grove and of Williams, cited in my paper of 1880, are farther considered in an essay on "Celestial Chemistry from the time of Newton," read by me in November, 1881, before the Philosophical Society of Cambridge, and reprinted from its *Proceedings* both in the *Chemical News* and the *American Journal of Science* for February, 1882. A perusal of this paper, to which Dr. Siemens alludes, will show that Sir Isaac Newton 200 years ago conceived the existence of an interstellar ether made up in part from emanations and exhalations from the atmospheres of the earth, the planets, and the sun, and from comets. He further conjectured this interstellary medium to contain "the material principle of life" and "the food of sun and planets," furnishing "the solary fuel," and being copiously absorbed by the sun "to conserve his shining." The relations of this interstellary matter to terrestrial life I have endeavoured to set forth in the paper just noticed. In connection with Sir William Thomson's calculation of the density of the luminiferous medium therein mentioned, the reader is referred to a recent examination of the subject by P. Glan, in the *Annalen der Physik und Chemie*, No. viii. 1879, in which he concludes that the lower limit of density would be more than 7000 times greater than that calculated by Thomson.

[1] In a paper on the subject of an interstellar medium, read by me before the French Academy of Sciences (*Comptes Rendus*, September 23, 1878, page 453), I spoke of it as affording, in accordance with the ideas of Newton and of Grove, a means of material communication between celestial bodies and added: "Cette théorie d'une échange universelle me paraissait fournir une explication de l'origine des poussières cosmiques."

Dr. Siemens has, in his paper, further suggested that solar radiation may effect the dissociation in interstellar space of the compounds of oxygen with carbon and with hydrogen, so that these elements may reach the sun in an uncombined state, and there be burned. He would thus make the sun not only a compressing-engine, but a furnace. While such a dissociation in outer space is not impossible, it is to be said that a preliminary decomposition, followed by reunion in the solar sphere, would in no way augment the ultimate calorific effect of compression there. The elements in the act of dissociation in space would absorb just as much radiant energy as would be set free by their subsequent combination, so that, whether the solar radiations are expended in heating or in dissociating the diffused matter, the final result in the sun would be the same. It may be further remarked, that from what we know of solar chemistry, dissociation of aqueous vapour and of carbonic dioxide is more likely to take place in the sun itself than in the cold regions of outer space.

While, therefore, his suggested addition to the hypothesis seems, if not untenable, unnecessary, we are grateful to Dr. Siemens for again bringing before us the grand conception which dawned upon the mind of Newton, but has found its fuller expression in our own day, and, as I have endeavoured to show in the papers already noticed, gives us the elements of a rational Physiology of the Universe. T. STERRY HUNT

Montreal, Canada, April 3

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THE two preceding letters by American men of science of well-known position, grant one of the three postulates upon which I grounded my solar plan, that of space filled with attenuated matter; they do not object to the second, and all-important one of the equatorial outflowing current; but they call in question the necessity of the third, that of dissociation of attenuated matter in space by means of arrested solar energy. Both my critics think dissociation in space unnecessary for the maintenance of solar energy, or as Dr. Sterry Hunt very clearly puts it: "Whether the solar radiations are expended in *heating* or in *dissociating* the diffused matter, the final result in the sun would be the same."

I would be disposed to agree with this dictum if taken as an abstract proposition, but I do not think that my critics can have subjected their view to calculation, the keystone without which the arch of speculation cannot be considered as secure. We know by experimental evidence that stellar space, and the matter filling it, are intensely cold, as proved by the winter-temperature of the polar regions; moreover water exposed even in the tropics to free radiation while insulated from the warm earth, freezes to a considerable thickness during a single night.

Let us suppose that the attenuated matter in space has a temperature of 160° on the absolute scale (being 114° below the freezing-point of water), and that it is 3000 times more rarefied than when it reaches by adiabatic comparison the solar photosphere. The rise of temperature due to this compression must be according to Rankine's well-known formula—

$$T_2 = T_1\left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}} = 1632^\circ \text{ absolute},$$

and this would make the solar photosphere 1358° on the Centigrade scale; this temperature is quite inadequate to produce the solar luminosity, which must require one equalling, though probably not exceeding that of the electric arc.

But assuming a compression of the attenuated atmosphere up to the photospheric density (which according to most authorities does not exceed terrestrial atmospheric density), there would still remain the predicament that although a higher maximum temperature could be reached by compression, very little of the heat due to it could be spared for the purpose of radiation, without sacrificing the possibility of disposing of the refrigerated gases again into space. The refrigerated gases would obey the law of solar gravitation to a much greater extent than the heated incoming gases, and would certainly not pass away into space, unless acted upon by a considerable extraneous force. The mere passage of the solar orb through space at a majestic pace which does not exceed one quarter of our orbital velocity, could not possibly produce such a result, and even the fan action advocated in my paper would fail to work in opposition to a large determining influence of solar gravitation.

These conditions are entirely changed if we assume, in addition to adiabatic compression and re-expansion, a further source of heat such as is produced in combustion. One pound of hydrogen develops in burning about 60,000 heat units, and one pound of marsh gas 24,000 heat units; in my article upon this subject, published in the April number of the *Nineteenth Century*, I showed that if only one-twentieth portion of the gases streaming in upon the polar surfaces at the pace of 100 feet a second were combustible gases, they could produce an amount of heat more than sufficient to account for the entire solar radiation as determined by Herschel and Pouillet.

There is no reason for supposing that the instreaming gases would penetrate beyond the solar photosphere; they would flash into combustion whenever their temperature by adiabatic compression had reached the limit of spontaneous ignition without the presence of an igniting solid, a point which, if determined experimentally, would give a clue to the real vapour density of the photosphere; and after reaching the point of dissociation, combustion would continue in the measure of the abstraction of heat by radiation, thus producing a vast accumulation of igneous matter of comparatively low density. This would flow on, in the manner of a floating body, above the denser gases or vapours forming part of the permanent body of the sun, towards the equatorial regions, whence it would be propelled into space at a temperature exceeding to some extent that of the inflowing gases after compression, but before combustion, thus aiding, instead of retarding the supposed solar fan action.

The fan-action itself would be produced, no doubt, at the expense of solar rotation; but, in order to appreciate this retarding influence at its true value, it must be borne in mind that the flow of gases once established has only to be changed in direction; the velocity acquired by the inflowing gases is simply transferred to the outflowing current diminished by an amount of rotative force sufficient to cover frictional retardation. The very interesting leading article in last week's NATURE, regarding the solar observations in America, during the last eclipses, now published for the first time, furnishes an unexpected and most striking corroboration of the solar fan-action which I had ventured to put forward as a necessary consequence of solar rotation in space filled with attenuated matter.

I am well aware that my paper read before the Royal Society does scant justice to those who have devoted much time and ingenuity to the subject of solar physics, and that, moreover, many points of considerable interest connected with the views I advocate have been indicated only, instead of having been fully developed; but, on the whole, I thought it was better to present my views in mere outline before an audience well acquainted with our present information regarding solar physics, and with only half an hour's time at their disposal.

The elaboration of such a subject would necessitate the writing of a book rather than of a paper, and perhaps Dr. Sterry Hunt, who has already done so much to elucidate our present knowledge of solar physics, may be induced to extend his labours in this direction. C. W. SIEMENS

12, Queen Anne's Gate, Westminster, April 26

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## Silurian Fossils in the North-West Highlands

MY friend, Mr. Hudleston, in his letter on the Silurian fossils in the North-western Highlands, states very clearly a point which at the present time is of the highest importance to all students of the metamorphic rocks. If it can be proved that the Durness limestone, which contains undoubted lower Silurian fossils, is identical with the series in Western Sutherland and Ross, which Mr. Hudleston terms the quartzo-dolomitic, then the so-called "Newer Gneiss" must be more recent than it, and thus must be a metamorphosed representative of some part of the Silurian series. This would prove that very great regional metamorphism has taken place in the latter half of the Palæozoic period; and that its mineral condition will not aid us materially in determining the age of a rock which has once been stratified.

But is this identity proved; and is it certain that the Durness limestone is more ancient than the Newer Gneiss series? I have not myself had the opportunity of investigating the Durness region, though I have examined several specimens of its limestone; and from the condition of these and my knowledge of parallel cases, and of metamorphic rocks in general, do not hesitate to say that I should require very clear stratigraphical evidence before I could believe the Durness limestone to underlie the "Newer Gneiss." The former is no more metamorphic than are several of the Palæozoic limestones; the latter is always considerably, sometimes rather highly, metamorphosed. But in

the quartzo-dolomitic series the amount of metamorphism, though the materials are not favourable for its production, is considerable; and the rock has a general resemblance to some of the impure calcareous bands which are incorporated with true schists in the Alps.

Further, although our knowledge does not at present enable us to speak dogmatically on this point, the weight of evidence is, in my opinion, strongly against the probability of the Newer Gneiss series being altered Silurian rock. I would even go so far as to say that it is such as to throw the *onus probandi* on those who assert its (comparatively) modern date. For five or six years I have been working—I trust without prejudice—at the question of the age of metamorphic rocks, during which time I have visited typical districts in Cornwall, Wales, Scotland, and the Alps; and in every case have been driven to the same conclusion, namely, that wherever extensive regional metamorphism exists, the antiquity of the rocks is very great, so that they are probably anterior to the Cambrian period. I fully expect that when the Durness region is closely scrutinised, it will be found that this fossiliferous limestone is faulted down against the metamorphic series, exactly (for instance) as the so-called Devonian rocks of the Lizard are faulted against the "hornblende schists" of that district, and are a remnant, thus preserved, of a more modern and wide-spread series. Any geologist who would settle this point for us would be entitled to our gratitude, but to do it will require no ordinary conjunction of qualifications; for he must be a practised microscopist, a skilled worker in the field, and a man who cares for truth more than for the traditions of an office, or even his own preconceived opinions.

23, Denning Road, Hampstead T. G. BONNEY

WITH regard to Mr. Hudleston's letter on the above subject, published in NATURE (vol. xxv. p. 582), I am glad to say that I am still alive, and able to give a part, at least, of the desired evidence for connecting the Durness limestone with the rocks of Assynt and Erribol.

In the year 1858 I accompanied Sir Roderick Murchison, while on a geological tour in Sutherland. During our stay at Inchnadamff, one of our excursions led us together up the River Traligill. Opposite the place where the springs issue from the miniature limestone caverns, about two miles above the bridge, I espied the fossils in dispute—"orthoceratites"—partially weathered out of the dolomitic limestone from which the stream issues. So overjoyed was I, that I called Sir Roderick to my side by shouting "Eureka," as I was a little in advance of him, pointed out the fossils *in situ*, and after hammering them out of their bed, handed them to him. The circumstances of the achievement are indelibly impressed on my memory. As I only saw these fossils in the field, I am not able to tell to what species they belonged; but there can be no doubt of their nature, as in my attempt to hammer them out of the rock, one of them was broken in such a manner as to expose the septa and the siphuncle.

On a subsequent visit which I made to Sutherland, I had the good fortune to see the specimen of *Orthoceras* (*Cameroceras*) *Brongniartii* alluded to by Mr. Hudleston as "having been found in the upper quartz-rock of Erribol." It was in the possession of the finder, the late Mr. Clark, of Erribol House, who kindly allowed me to examine it. Mr. Clark accompanied me to the place, and pointed out the exact spot where he got the specimen—a little to the north-east of Erribol House.

CHAS. W. PEACH

30, Haddington Place, Edinburgh, April 24

## The Magnetic Storms

THE magnetographs at the Kew Observatory were a little disturbed from about 11 p.m. of the 13th inst. to 7 p.m. of the 14th inst. During the 15th they were quiet, and remained so up to 11.45 p.m. of the 16th, when the disturbance began by an increase of the declination, an augmentation of the horizontal force, and a diminution of the vertical force. The movements of the declinometer became gradually more rapid after 2 a.m. on the 17th, whilst its oscillations extended farther and farther from its normal position principally in the direction of increased westerly declination.

From 4.30 to 9 a.m. the horizontal force had diminished so much that the trace frequently passed off the paper and the register was lost for a while. At this time the force must have been more than ·05 mm.mgrs. below its average value.

The minimum of vertical force occurred at 5.55 a.m., when it was about 0·07 units too low.

From 10 a.m. to noon of the 17th the motion of the declinometer was small, whilst the components of magnetic force were rapidly increasing in intensity, until at 0.15 p.m. both traces left the photographic sheet in the direction of augmented force; at this time the declination needle merely oscillated rapidly about its ordinary position.

The horizontal force instrument recommenced to record about 2 p.m., and the vertical force about 2.45 p.m.; afterwards the movements of all three gradually diminished, and at about 8 p.m. the disturbance had died out.

During the 18th and 19th the magnets remained unaffected, but at 3.45 a.m. of the 20th a second disturbance set in, commencing with a rapid increase of declination, the first swing of the magnet carrying it nearly a degree to the westward, whence it returned at 4.30 a.m. Its mean position was reached at 6 a.m., and then its oscillations became very rapid, and continued so until 2 p.m., after which hour they became less; but the effect of one disturbance lasted until 7.30 a.m. of the 21st.

Both forces were also simultaneously disturbed, but their movements were much more limited than on Monday, the extremes being in the horizontal ·04 mm.mgrs., and in the vertical 0·3 mm.mgrs. only. G. M. WHIPPLE

Kew Observatory, April 24

## Colour Perception

WHILE working at dry-plate photography in a ruby light, I noticed that when any light-coloured article, such as the hand, was rapidly moved, it appeared of a brilliant greenish-blue, in which blue predominated, while, when slowly moved, it appeared of the same colour as the other objects in the room. Seeking for an explanation, led me to recognise a new fact about colour perception which may be of interest to your readers. The reason of the hand appearing blue when in rapid motion was because the continual use of the red light had fatigued that part of the retina responsive to it, and the light reflected from the hand impinging for a very short time on the retina, was not strong enough to excite the sensation of red, but was quite sufficient for blue, the nerves responding to this colour having been rendered acutely sensitive by complete rest. To test this hypothesis, I obtained some dark blue glass and applied it to the window of the dark room, removing the red. On repeating the experiment, the eye with its blue sense exhausted, saw rapidly-moving objects reddish. Now from this it is clear that it takes a longer time to cause a sensation in an exhausted than in a fresh organ. It also gives a direct proof of Helmholtz's suggestion, "that actual coloured light does not produce sensations of absolutely pure colour; that red, for instance, even when completely freed from all admixture of white light, still does not excite those nervous fibres alone which are sensitive to impressions of red, but also to a very slight degree those which are sensitive to green, and perhaps to a still smaller extent those which are sensitive to violet rays" ("Popular Scientific Lectures," first series, p. 223). These observations have led me to an explanation of a very curious phenomenon brought under my notice by my friend, Mr. Napier Smith. When discs of paper on which black spaces have been marked, so that on rotation the eye receives impressions of black and white too rapidly to notice the pattern, but too slowly to combine into a neutral gray, the rotating card appears to be distinctly coloured, especially when it is looked at without keen attention, or as we may say passively. All colours may be seen, but red and blue were the most distinct to me. I at first thought that the colour might arise out of the paper and ink, the former being perhaps tinted with blue to whiten it in manufacture, and the latter probably a dark brown; but on looking several times at the solitary discs, and acquiring the power of looking passively the intensity of the colours could not be so accounted for. The true explanation is found, I believe, in the fact that the different colour organs require longer or shorter periods of excitation before responding to the stimulus, and that those which require the longest periods also retain the sensation longest. I have only made very rough trials, but they point to the fact that the eye responds quickest to red, so that the most rapid alternations will appear reddish, a little slower green will come in, and cause some indescribable colours, such as are seen in the polariscope, and lastly, when green and red are about equal, and producing white, blue will be seen. The blue is best seen with a slo-

rotation, and a large amount of black, because the red and green impressions have time to die out, and the blue (the most persistent) remains alone, showing like a fine fluorescent layer overlying the disc. I have not at present the time, or I would attempt to find out the excitation-periods for the different colours by this method, and I believe that a finer mode of applying it might determine the real number of colour-sensations, and allow of a decision being arrived at between the theories of Young and Hering.

J. B. HANNAY

### Dispersal of Freshwater Bivalves

IN the late Mr. Darwin's interesting contribution upon this subject (NATURE, vol. xxv. p. 529), mention is made of the fact that the newts in Mr. Norgate's aquarium "frequently have one foot caught by a small freshwater bivalve (*Cyclas cornea ?*)." It is, perhaps, worth calling your readers' attention to a passage which occurs in Mr. Knapp's "Journal of a Naturalist" (2nd ed., p. 316), published in 1829, wherein, speaking of the newt, he says: "I have seen the boys in the spring of the year draw it up by their fishing lines, a very extraordinary figure, having a small shell-fish (*Tellina cornea*) attached to one or all of its feet; the toes of the newt having been accidentally introduced into the gaping shell, in its progress on the mud at the bottom of the pool, or decidedly put in for the purpose of seizure, when the animal inhabitant closed the valves and entrapped the toes. . . ."

This record, coupled with Mr. Norgate's statement in the article referred to, that "newts migrate at night from pond to pond, and can cross over obstacles which would be thought to be considerable," seems to point to the fact that the dispersal of bivalves by this means is more general than might at first be supposed.

FRANK J. ROWBOTHAM

### The Horse in Motion

IN NATURE, vol. xxv. p. 591, you notice the publication of a work entitled "The Horse in Motion," by Dr. Stillman, and remark: "the following extract from Mr. Stanford's preface shows the exact part taken by each of those concerned in the investigations." Will you permit me to say, if the subsequently quoted "extract" from Mr. Stanford's preface is suffered to pass uncontradicted, it will do me a great injustice and irreparable injury. At the suggestion of a gentleman, now residing in San Francisco, Mr. Stanford asked me if it was possible to photograph a favourite horse of his at full speed. I invented the means employed, submitted the result to Mr. Stanford, and accomplished the work for his private gratification, without remuneration. I subsequently suggested, invented, and patented the more elaborate system of investigation, Mr. Stanford paying the actual necessary disbursements, *exclusive* of the value of my time, or my personal expenses. I patented the apparatus and copyrighted the resulting photographs for my own exclusive benefit. Upon the completion of the work Mr. Stanford presented me with the apparatus. Never having asked or received any payment for the photographs, other than as mentioned, I accepted this as a voluntary gift; the apparatus under my patents being worthless for use to any one but myself. These are the facts; and on the bases of these I am preparing to assert my rights.

449, Strand, W.C., April 26 J. MUYBRIDGE

## *DAILY WEATHER CHARTS IN THE NORTH ATLANTIC*

WE append to this notice one of the most important statements hitherto issued from the Meteorological Office, from which it will be seen that the Meteorological Council have resolved to undertake the preparation of Daily Weather Charts of the North Atlantic for the thirteen months commencing next August. The scheme will, without doubt, call forth a co-operation equally hearty on the part of the owners, captains, and officers of sailing vessels and steamers which cross the Atlantic.

The figures of the wreck returns for the four years ending with June, 1880, show a striking diminution year by year, resulting as regards the gross totals in a steady reduction from 1805 in 1876-77 to 891 in 1879-80, or less than half the losses and casualties to shipping attributable to causes connected with the weather round the British coasts. No small part of this gratifying result may fairly be claimed as due to a gradual improvement in weather-forecasting and to a more intelligent attention now generally given to observational and instrumental indications of coming storms by those who man our fishing boats and coasting vessels. That much, however, yet remains to be done in some quarters by disseminating even the merest elementary notions of the subject was shown by the lamentable loss of life on October 14, 1881, on the morning of which day whole fleets of boats left the harbours and stood out to sea in the face of a barometer which had during the previous twelve hours gone down more than an inch.

The object aimed at is better and fuller information than is yet possessed as to the origin, development, and progressive movement of the storms which occur over the Atlantic. This information will not only immediately benefit seamen, but also promote the science of meteorology, and thus tend directly to the improvement of the weather forecasts and storm warnings issued to the British coasts by rendering easier and more certain the interpretation of the first indications of approaching changes noted at the western stations in Ireland and Scotland. The commencement of the observations in August next has been happily chosen, it being then that observations also begin at the international Arctic stations, which have been planted by different nationalities in Kamschatka, Siberia, Nova Zembla, northern Scandinavia, Greenland, and Arctic North America. There will thus be brought to bear on the examination of the Atlantic storms a fulness of information gathered from these floating and stationary observatories which will so largely extend the field of observation chiefly on what we may call the weather-side of Europe, not hitherto attainable, which cannot but be productive of solid advantages to our seafaring population, and to all whose material interests may be benefited by a knowledge beforehand of weather changes.

The Meteorological Council, however, act wisely in warning against being over-sanguine as to the importance of the results to be obtained by the inquiry they are about to undertake. No decidedly great step is likely to be taken in the improvement of weather forecasting, as regards time and precision, until either of two things be done, namely, till either a cable be laid to Newfoundland, *viâ* Faro, Iceland, and Greenland, or till science has taught us to moor a ship 700 or 800 miles out in the Atlantic, as a floating meteorological observatory, connected by cable with the west of Ireland.

The observations of the temperature of the surface-water of the Atlantic it is proposed to make from the equator northwards, is one of the most important features of the investigation. By these observations, continued widely and uninterruptedly over a space of thirteen months, the great practical question of the bearing of the temperature of the surface-water of the Atlantic, particularly between lat. 30° and 50°, on the character of coming seasons, can be investigated, and different theories on the subject be put to the proof. To take an example—it has been inquired (NATURE, vol. xxi. p. 142) whether, when the temperature of the Atlantic to the south-west of the British Islands, is decidedly above the normal temperature of the season, it does not follow, owing to the larger evaporation and other resulting effects, that Atlantic storms take a more southerly course than usual in their passage across Europe. If the storms of any particular winter pursue an easterly course to southwards, of the British Islands, that winter will, like the winter of 1870-71, be a severe one; but if, on the other hand, these storms pursue a course to the northward, the winter will partake more or less of the mildness of the winter we have just passed through. Since the character of the season thus depends on the line followed by the atmospheric disturbances which occur, it results that if the track of the storms be dependent on the amount of evaporation from

he Atlantic, the general character of the weather of any coming season may be foretold.

The following statement has been issued from the Meteorological Office, London :—

"The Meteorological Council propose to undertake the preparation of daily weather charts of the North Atlantic Ocean for the thirteen months beginning on August 1 in he present year, and ending on August 31, 1883.

"It is well known that the changes of weather which we experience are in general caused by atmospheric disturbances, which travel more or less rapidly, and undergo more or less modification during their progress. By far the larger number of the disturbances which visit the British Islands arrive on our shores from the Atlantic Ocean, and our earliest information as to any impending change is consequently derived from telegraphic reports from the Atlantic coasts, especially from the British stations at Stornoway, Mullaghmore, and Valentia, and occasionally from the Continental observatories at Rochfort and Corunna. But of the origin and previous history of these systems we have no sufficient knowledge, except in a few isolated cases.

"The Meteorological Council believe that any systematic information which can be obtained as to the origin development, and laws of motion of the atmospheric disturbances which occur over the Atlantic Ocean would promote the science of meteorology and be of immediate benefit to seamen traversing the Atlantic Ocean, and would tend directly to the improvement of the forecasts and storm warnings issued to the British coasts, by rendering the interpretation of the first indications of approaching changes observed at the western meteorological stations more easy and certain.

"The importance of a systematic study of the weather of the North Atlantic Ocean has long been recognised, and series of daily synoptic charts, more or less resembling those now in contemplation, have been prepared at various times, not only by the Meteorological Office, but also by the Association Scientifique de France under the guidance of Leverrier, by Capt. Hoffmeyer, of the Danish Meteorological Institute, by the Deutsche Seewarte, at Hamburg, and (as a part of a wider plan) by the Chief Signal Office of the United States. But none of these charts, however valuable in other respects, supply adequate materials for a satisfactory discussion of Atlantic weather, chiefly on account of the small number of the observations upon which they are founded as compared with the magnitude of the area over which they are spread.

"Evidence of the interest attaching to the connection between English and Atlantic weather is afforded by the efforts which have been made during the last few years by the proprietors of the *New York Herald* to transmit to England from America telegraphic predictions of approaching disturbances, which (it is presumed) are founded on the reports of vessels arriving in America from the Atlantic Ocean. Reports such as these from a large number of vessels would be of great value ; but the predictions taken by themselves cannot be utilised in a scientific investigation of weather.

"The Meteorological Council gratefully acknowledge the large measure of invaluable help which they have hitherto received from seamen and the shipping interest generally. But as the object now proposed can only be achieved by the voluntary cooperation of an increased number of observers, they feel justified in making a special appeal for assistance to the owners, captains, and officers of ships, and especially to the great companies whose steamers ply between this country and America. In a science which, like meteorology, is still in its infancy, every advance is attended with great difficulties, and the Council are well aware that it would be easy to be too sanguine as to the importance of the results to be obtained by the inquiry which they are about to undertake. But having regard to the loss of life and property occasioned by storms on our coasts,[1] they feel confident that their proposal will commend itself to the public generally, and will insure the active co-operation of those classes of the community for whose benefit it is primarily intended.

"It is proposed to ask for observations of the barometer, of open air and sea-surface temperatures, wind (direction and force) and weather at 8 a.m. and noon each day, with the position of the ship at noon.

"Forms for recording the observations will be supplied by the Meteorological Office, 116, Victoria Street, London, S.W., on application to the Marine Superintendent."

## *PISCICULTURE IN THE EDINBURGH FISHERY EXHIBITION*

IT was a happy thought of the promoters of the Fishery Exhibition to secure the Aquarium for the use of their visitors. Although it is on a small scale, it adds largely to the amenities of the exposition, and must prove a novel sight to many inland visitors. At most of the French fishery exhibitions, and at Arcachon in particular, an aquarium proved one of the greatest of the many attractions provided for the thousands who came to the châlet which contained the general exhibits. It must be confessed, however, that the French made more use of their aquarium than the directors of the Edinburgh Exhibition seem inclined to do—we miss some of the wonders of the deep in the shape of "fancy fishes," which we think might have been included in the present "show." There is one exhibit, however, which helps to make up for numerous deficiencies; we allude to entry No. 23 in the Catalogue, which is as follows :—

> Musynski, Constantine, St, Petersburg.
> 10,000 live fry of the species *Coregonus Bacri* (Sigue), sent from St. Petersburg to this Exhibition (see in Aquarium).

There is much more in this simple entry than all at once meets the mind's eye. The fact of these young fish being in Edinburgh signifies a piscicultural feat of great importance. That impregnated fish eggs can be, and have been forwarded to great distances we know, but, as regards young fish, it has hitherto been a pretty general opinion that it would not be safe to send them a journey that would occupy a longer period than from twenty to thirty hours. Now we are disillusioned as to that : in the Waverley Hall, at Edinburgh, we see ten thousand young fish in a healthy and lively state, that have come from a place which is two thousand miles distant. The problem of supplying these young fish with air during their long journey was solved in a very simple way, a glass tube of small diameter being inserted in the cork, whilst the shape of the great bottle (a carboy?) in which the fish travelled, insured the constant motion of the water. At all events, in whatever way this feat was accomplished, the young fish arrived in safety, the percentage of deaths being of no consequence—not 3 per cent., we believe. In connection with this Russian gift, a vexed question has arisen at the Exhibition. Put in simple form, it is, Now that we have got these fish, what use can we make of them? It is quite clear that we cannot return them to Russia, and whether it would be safe to add them to the stock of any of our lochs has given rise to much controversy. It was first of all proposed to place them in Loch-

[1] The wreck return published by the Board of Trade for the year ending June 30, 1880 (C. 2506) (the last published). gives on p. 20 the following list of casualties on our coasts attributable to causes connected with the weather :—

| | | Total Losses. | Serious Casualties. | Minor Casualties. | Total. |
|---|---|---|---|---|---|
| 1879-80 | Founderings | 16 | 0 | 0 | 16 |
| | Strandings | 81 | 108 | 178 | 365 |
| | Other causes | 0 | 105 | 405 | 510 |
| Totals for 1879-80 | | 97 | 213 | 581 | 891 gross total |
| ,, 1878-79 | | 121 | 227 | 761 | 1,109 ,, |
| ,, 1877-78 | | 138 | 289 | 1,002 | 1,429 ,, |
| ,, 1876-77 | | 180 | 367 | 1,258 | 1,805 ,, |

leven, but, at such a prospect, anglers have taken alarm, fearful lest the newcomers, when they have attained their full size, may devour the "finest trout in the world"—*Salmo levensis*—a fish which has been compared with the *Fario lemanus* of the Lake of Geneva; and in consequence of this opposition of the anglers, the Coregoni will probably find a home in Duddingston Loch, near Edinburgh, which, however, is much too small for such a large number of fish. Why not place the Russians in some of the lakes of Scotland, which already contain similar fish, in the town loch of Lochmaben, for instance, the home of the *Vendace*, or in Lochlomond, where may be seen the *Powan?* Or some hundreds of them might be sent to Loch Neagh in Ireland, which contains the *Pollan*. Hoping that a suitable home may be found for these finny treasures, it will be interesting to note their future growth, to ascertain when they breed, how long it is till the spawn comes to life, and at what age the fish become reproductive.

The Edinburgh Exhibition is undoubtedly indebted to Sir James Gibson Maitland for a good show of young fish; "live Salmonidæ artificially reared," at his extensive fishery of Howietoun near Stirling, where there is accommodation for the hatching of many millions of fish eggs. Sir James has directed his attention chiefly to the breeding of the trout of Lochleven, in which he has been exceedingly successful, also salmon, and the common trout of the country, as well as the *Salmo Fontanalis* of America. Howietoun is a commercial fishery, from which supplies of fertilised eggs and "eyed ova" of the fishes named may be procured at a given price. The proprietor has an exhibit in the Waverley Hall (No. 163 in Catalogue) of hatching and other apparatus incidental to the piscicultural operations carried on at his fishery. It has been found in the course of the routine work at Howietoun, that it is possible to transport eyed-ova with perfect safety to any part of the United Kingdom, and apparatus are shown suitable for the transport of large trout, providing for the automatic aëration of the water by means of a wedge of perforated zinc in the lid; there is also shown a "packing-case for transport of ova for long distances, with air chamber, ice tray, and ventilation of ova." It may interest persons interested in Pisciculture to know that the chief food supplied to the young fishes at Howietown is horseflesh, three or four horses being used every week; the Lochleven trout are fed on clams procured from the Firth of Forth, and Sir James Maitland, we believe, is also growing snails for the purpose of feeding the young fish.

It may, we think, be taken for granted that the piscatorial feat which we have recorded, the transport of the fry from St. Petersburg to Edinburgh will give such a decided fillip to piscatorial operations of all kinds as may prove beneficial; there are many barren sheets of water which might be advantageously populated with some one or other of the many species of the finny tribe, whilst proprietors of lakes or rivers which are tending to barrenness cannot do better than restock them with fry of the far-famed Lochleven trout, or of the *S. fontanalis* of America, the latter for running streams, the former for sheets of water of some magnitude.

## THE EDINBURGH CHAIR OF NATURAL HISTORY

PROF. RAY LANKESTER, who has resigned the Edinburgh Chair of Natural History, which he accepted a fortnight ago, has requested us to publish the following statement:—

I have elsewhere stated the reasons which have led me, with very great regret and after anxious consideration, to withdraw from the honourable position of Regius Professor in the Edinburgh University, before actually entering upon the duties of the office. They, briefly stated, amount to this—that I had formed a mistaken estimate as to the extent to which the Professor's time would be occupied, the appliances at his disposal, and the security of his emoluments. For this mistake I am anxious to state that I accept the painful responsibility. At the same time I desire to say to those to whose support and interest in the matter I have been and remain so deeply indebted, that the warmth of the contest, which has occasioned no small expenditure of time and trouble to them—expenditure which I must ever remember with gratitude, and unfortunately also with deep regret—explains and, I hope, may be considered as excusing the tardiness of my arrival at a correct estimate of the desirability of exchanging my position in London for that in Edinburgh.

I have also to explain that it was solely a desire to give the least inconvenience possible to the authorities, which led me to communicate my resignation, and the reasons for it, to those whom it affected, *without any delay*. It has been pointed out to me, that my action may have appeared abrupt, and wanting in consideration for others. I should wish, on the other hand, to say that the reflection that my resignation must cause considerable disappointment, and even annoyance, to those whom I had most reason to spare such feeling, led me to hesitate in taking action, until the necessity for making arrangements both in Edinburgh and in London, was so pressing, as to make the immediate statement of my intentions, to all persons concerned, imperative.

Lastly, I should wish to state that I should find my regret for the present occurrence greatly increased, were it supposed that I do not recognise the dignity and importance of the University of Edinburgh, and the high position of its professors. I can only say, that I am sincerely sorry that circumstances should render it, in my opinion, desirable to forego the honour of entering upon that association with the University which was contemplated, and of working with colleagues for whom I, in common with all men of science, have the greatest respect and esteem, and amongst whom I am proud to reckon personal friends.

E. RAY LANKESTER

## ON THE RELATIVE RESISTANCES OF LAND AND WATER TO WIND CURRENTS

IN 1878 I received a grant from the Government Research Fund for the purpose of ascertaining the law of variation of wind velocities at different heights: and I found that the curves traced out by the velocities in relation to the heights were most nearly represented by the formula $V = v\sqrt{\frac{H+72}{h+72}}$, where $H$ and $h$ represent respectively the heights in feet of the high and low level stations above the ground, and $V$ and $v$ the respective velocities at those levels.

I have since then been making observations with the view of ascertaining the relative resistance of land and water to the aërial currents. These observations are very far from being complete, but I give the following results in the meantime, as they may be interesting.

| | | Sand. | Water. | | |
|---|---|---|---|---|---|
| 6″ waves | ... | 12·8 | : 13·8 | miles per hour | = 1 : 1·08 |
| 6″ ,, | ... | 13·65 | : 14·375 | ,, ,, | = 1 : 1·06 |
| 3″ ,, | ... | 7·96 | : 9·19 | ,, ,, | = 1 : 1·155 |
| | | Grass. | Water. | | |
| 9″ ,, | ... | 8·4 | : 10·7 | ,, ,, | = 1 : 1·274 |
| 3″ ,, | ... | 10·13 | : 14·75 | ,, ,, | = 1 : 1·456 |

The velocities given are the means of observations taken every five minutes for about an hour.

From this it will be seen that the resistance is least for water, somewhat greater for smooth sand, and greater still for grass. Further observations are not only required on this subject, but also on the velocity of the wind over the water in relation to the height of the waves.

Edinburgh, April 18 THOMAS STEVENSON

## ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

### VII.

17. HARDWICKE'S CIVET-CAT (*Hemigalea Hardwickii*).—The Viverridæ, or Civet-cats, form a well-marked family of carnivorous mammals peculiar to the tropics of the Old World, and mostly confined to Southern Asia and Africa, though one or two of them occur in the southern parts of Europe. One of the finest and largest of them is the True Civet-cat (*Viverra civetta*), from the anal glands of which the old-fashioned perfume known as civet is extracted, and the Genets, Ichneumons, and Mungooses are well-known members of the same family, examples of which are always to be seen in the Zoological Society's Collection.

Amongst the rarer and less familiar forms of the Viverrine groups is the very curiously-marked animal which we now figure (Fig. 17) from a specimen received by the Society in October, last year. Hardwicke's Civet, though first described by Dr. Gray so long ago as 1830, is a very scarce and little-known species, and the present example is believed to be the first of its kind ever brought alive to this country. In 1840 Müller and Schlegel gave an excellent figure and desciption of this animal, under the name of *Viverra boiei*, in their great work upon the Natural History of the colonial possessions of the Netherlands. Their specimen was obtained in South-Eastern Borneo by Herr Henrici, and sent alive to the Gardens of the Zoological Society of Amsterdam. Hence, after its death, it was transferred to the National Museum of Leyden. Müller adds that he never met with this Civet-cat himself during his extensive travels in the Eastern Archipelago, and had received no information as to its habits.

Hardwicke's Civet-cat was also figured and described by Eydoux and Souleyet in the "Zoology" of the voyage of the *Bonite* in 1841, under the name *Hemigale zebra*, but again without any information as to its habits, not even the locality of their specimen being stated.

So far as has been ascertained from the Zoological

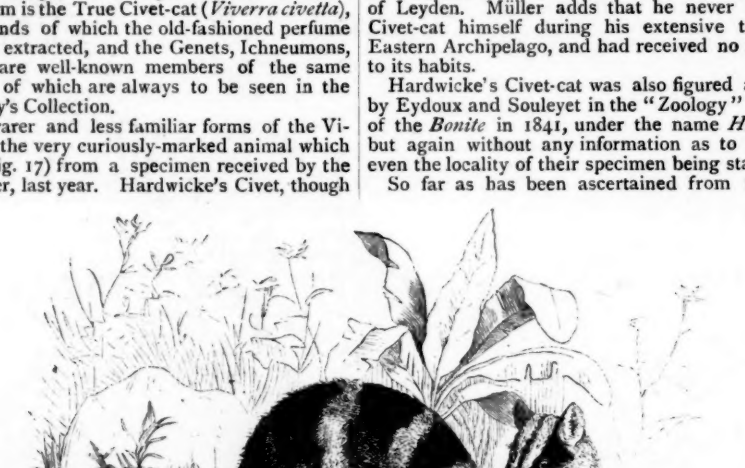

FIG. 17.—Hardwicke's Civet-cat.

Society's living specimen, this animal is excessivly shy and retiring in disposition, and apparently does not leave its retreat voluntarily except at night. When handled, it ejects a highly acrid and skunk-like secretion from its anal glands. The length of the body in the example figured is about 24 inches, and that of the tail about 18 inches.

18. The Warty-faced Honey-Eater (*Meliphaga phrygia*).—No group of animals is more characteristic of the peculiar fauna of Australia than the great family of Honey-Eaters (Meliphagidæ), of which upwards of sixty species, belonging to many different genera, are distributed throughout the length and breadth of that Continent. But although the Honey-eaters are so common in Australia, and there is an extensive importation of living birds from Sydney and other Australian ports every year into this country, very few of the Meliphagidæ have yet reached Europe alive. Almost the only Honey-eater habitually imported living—is the so-called Parson-bird (*Prosthemadera Novæ Zeelandiæ*) of New Zealand, which is much valued in that colony as a cage-bird, and thus finds its way not unfrequently to London. The fact is, that the organisation of the Honey-eaters, being adapted for an active and wandering life, in perpetual search of the nectar of the flowering-trees which their pencilled tongue so admirably fits them to collect, does not render them very suitable subjects for captivity, and it is only recently that means have been found to preserve these birds alive and in good health in cages. It has thus happened that almost the only one of the vast tribe of Australian Honey-eaters that has been exhibited in the Zoological Society's aviaries is the present species, which we now figure (Fig. 18) from four examples lately received from New South Wales.

In his great work on the "Birds of Australia," Mr. Gould tells us that the Warty-faced Honey-eater is not only one of the handsomest of its tribe, but also one of the most beautiful birds inhabiting Australia, the strongly contrasted tints of its black and yellow plumage rendering it a most conspicuous and pleasing object, particularly during flight.

Although very generally distributed, its presence ap-

[1] Continued from p. 393.

pears to be dependent upon the state of the *Eucalypti*, upon the blossoms of which it mainly depends for subsistence; it is consequently only to be found in any particular locality during the season that those trees are in blossom. It generally resorts to the loftiest and most fully-flowered tree, where it frequently reigns supreme, buffeting and driving every other bird away from its immediate neighbourhood; it is, in fact, most pugnacious, evincing particular hostility to the smaller *Meliphagidæ*, and even to others of its own species that may venture to approach the trees upon which two or three have taken their stations.

Mr. Gould further tells us that the nest of the honey-eater, which is usually constructed on the overhanging branch of a *Eucalyptus*, is round, cup-shaped, about five inches in diameter, composed of fine grasses, and lined with a little wool and hair. The eggs are two in number, of a deep yellowish buff, marked all over with indistinct spots and irregular blotches of chestnut-red and dull purplish grey, particularly at the larger end, where they frequently form a zone; they are eleven lines long, by eight lines and a half broad.

The stomachs of the specimens killed by Mr. Gould were entirely filled with honey; insects, however, he says, doubtless form a considerable portion of their diet.

The examples of the species now in the Zoological Society's Gardens are four in number, and apparently form two pairs, but there is little or no external difference between the sexes. They are lodged in one of the large cages at the back of the "Insect-house," and show every sign of good health. It is even hoped that they may nest and breed in captivity.

19. The Lobed Musk-duck (*Biziura lobata*).—Water-fowl have always formed a favourite portion of the Zoological Society's living collection, and a considerable number of species of swans, ducks, and geese of various sorts have from time to time reproduced their kind in the ponds and inclosures in the north garden. Many of these have been introduced by the Society for the first time into Europe, and have thence found their way into the other Gardens on the continent.

Owing to the great success which has attended their efforts in these directions, the Society are always specially anxious to add new species to this branch of their living series, and it is with great satisfaction that every new addition to the already long list of "acclimatisable" Anatidæ is announced in their journals. The species which is now portrayed (Fig. 19) is certainly one of the most remarkable that they have yet procured, and although perhaps not likely to be "acclimatised" at present, is well worth examination as being remarkable even amongst Australian animals, for several very abnormal features in its structure. Mr. Gould, to whose great works every writer upon the mammals and birds of Australia must not fail to turn for information, tells us that the Musk-duck belongs to a genus of which only a single species is known, and which is singularly different from every other member of the *Anatidæ*; so different, in fact, that although like Bonaparte, he has placed it next to *Erismatura*, he believes its alliance to that form is but a seeming one. "There is something about this extraordinary bird," Mr. Gould continues, "which reminds one of the cormorants"; yet no ornithologist

FIG. 18.—Warty-faced Honey Eater.

FIG. 19.—The Lobed Musk Duck.

would, he presumes, associate it with those birds. "Like many other of these antipodean forms, it must be regarded as an anomaly; it is, in fact, a *Biziura*, and nothing more, for it stands alone."

The Musk-duck has a lengthened, stiff, and leather-like appendage hanging from the under surface of the bill, and is the only member of the family which possesses this singular structure. Its lengthened tail, composed of twenty-four narrowed and stiffened feathers, is, no doubt, most serviceable to it in swimming and diving. The female does not carry the chin-lobe, and is very much smaller than the male bird.

The Musk-duck is widely distributed on the Australian Continent, and also inhabits Tasmania. As Mr. Gould tells us, it frequents the bays and inlets of the sea, the upper parts of rivers, lakes, and secluded pools. "More than a pair are rarely seen at one time; often a solitary individual takes up its abode in some favourite pool, where it lives a life of complete seclusion, depending for its food and for its preservation from danger upon its powers of diving rather than upon those of flying. It is very difficult to shoot, as it dives instantly a gun is fired, so that the shot has hardly time to reach it.

The male examples of this curious duck were purchased by the Zoological Society on February 8 last. They were not in good condition when received, and though the utmost care was taken of them, one of them is since dead. The other may be seen in one of the tanks at the end of the Fish-house.

## THE LIFE-HISTORY OF THE EEL

ALL persons interested in the mystery that until quite recently hung over the life-history of the eel, will find themselves under great obligations to W. Brown Goode for the very able and exhaustive account which he has quite recently published on this subject in the *Bulletin* of the United States Fish Commission, based upon the scholarly work of Jacoby, and from which we abstract the following. The number of species described by some authors is very large. Dr. Günther would seem to recognise only about twenty-five. Dareste still further reduces the number, making but four species in the genus Anguilla. *A. vulgaris*, occurring throughout the northern hemisphere in the New and in the Old World, *A. mowa* and *A. marmorata* in the Indian Ocean, and *A. megalostoma* in Oceania, and he further declares that even between these four the boundaries are not clearly defined. The habits of the eel are still not quite understood. So far as is known, it is the only fish, the young of which ascend from the sea to attain an imperfect maturity, and return to the sea to deposit their spawn. The economical value of the eel as a food fish has been now well established, and they easily admit of being artificially introduced into lakes and rivers. The reproduction of the eel has from the days of Aristotle given rise to the most wonderful conjectures and assertions. Leaving out of question such old theories as that the eels are generated from dew, slime, horsehair, and from the skins of old eels, it has been a matter of dispute for centuries whether the eel is an oviparous or a viviparous animal. The reproduction of the eel was a mystery to the learned Greeks. While they knew that other fishes deposited their eggs, no discovery of the eggs of eels was ever made by them. The Greek poets solved the mystery in an off-handed way; for as they were in the habit of assigning to Jupiter the paternity of all children not claimed by earthly fathers, so they attributed the progenitorship of the eels to the same Jove.

With the revival of the study of the natural sciences in the sixteenth century, we find that investigators turned their attention with great ardour to this special subject, and such renowned investigators as Aldrovandi, Rondelet, and Salviani published elaborate treatises on the generation of the eel; and they were followed by Albertus Magnus, Leuwenhoek, Elsner, Redi, and Fahlberg.

It was in the eighteenth century that for the first time the roe of the female eel was discovered. A surgeon of Comacchio, named Sancassini, in 1707, sent the ovaries, as he thought, of an eel, to the celebrated naturalist Valisneri, who sent an account thereof to the Academy of Bologna. Prof. Valsalva appears to have doubted the correctness of this discovery. The discussion continued. Pietro Molinelli offered a large reward for a gravid eel. In 1777 an eel presenting the same appearance as the one described by Valisneri was sent to Prof. Monti, who, being indisposed for the investigation, gave it over to a set of his favourite pupils, among whom was Camillo Galvani. These students pronounced the anatomical appearance to be the same as described by Valisneri, and the specimen was sent to Prof. Mondini for his opinion, which was published in the Bologna Academy's *Transactions*, to the effect that the ovary described by Valisneri was only the swimming bladder in a diseased condition. But in connection with this opinion Mondini gave and illustrated by magnificent plates a good description, and demonstrations of the true ovaries of the eel as found by himself. This classical work of Mondini has been often overlooked. Later, but quite independently of Mondini, the ovary of the eel was discovered by O. F. Müller Spallanzani's investigations in 1792 threw doubts upon the discoveries of Mondini and O. F. Müller, so that when Prof. Rathke in 1824 described the ovaries of the eel as two cuff and collar-shaped organs on both sides of the backbone, he was everywhere in Germany (and is to a large extent to the present day) regarded as the discoverer. The first picture of the ovary, after that of Mondini, and the first plate of the microscopical appearance of the egg of the eel was published in a dissertation by Hohnbaum Hornschuch in 1842, and the question of the ovary of the eel may be regarded as definitely settled by the publication by Rathke, in 1853, of a description of a gravid female eel, the first and only specimen of such which had come up to that time into the hands of an investigator.

The search after the roe in the eel was of much later date. In 1842 and up to 1872 the researches of several observers were unrewarded with success.

Of the various mistakes made in this investigation Dr. Jacoby gives us an interesting account. In the meanwhile the late Dr. Syrski, the Director of the Museum of Natural History at Trieste, had undertaken, at the request of the marine officials at Trieste, to determine the spawning-time of the fishes of this region, and he devoted a good deal of his attention to the *smaller* eels. On November 29, 1873, Dr. Syrski found in an eel, now preserved in the Museum at Trieste, which was fifteen inches long, a completely new organ, which had never before been seen within an eel by any former investigator, although tens of thousands of eels had been zealously studied. Syrski published his discovery in the *Proceedings* of the Vienna Academy for April, 1874, and, according to all the researches up to this time made, there would seem the highest probability that this organ of Syrski is actually the long sought, but immature male organ. The investigation cannot be said to be complete until the presence of spermatozoa is determined; but the recent discovery of such in the similar spermaries of the conger eel, by Dr. Hermes, of Berlin, is a strong confirmation. The eels with the Syrskian organ are smaller than the females, and are to be found only in the sea and brackish water. They have a short and sharply-pointed snout. Their dorsal fin is less broad, and not so high as in the females.

This discovery of Syrski drew attention anew to the solution of the eel problem. Among others, the German Fischerei-Verein in Berlin offered a reward of 50 marks to the person who should first find a gravid eel sufficiently developed to satisfy Prof. Virchow of the fact. Herr

Dallmer, of Schleswig, Inspector of Fisheries in that province, offered to transmit communications to Berlin, and in 1878 he published an interesting report of the proceedings. Quite beyond all his expectations, his wishes had been made known by the press to all the regions between the Rhine and the Weichsel, and from the Alps to the sea. The number of letters which he received at first gratified him, next surprised him, and finally so terrified him, that at last he was obliged to refuse to attend to communications. Prof. Virchow also received an incredible amount of letters from all parts of Germany, and in a little time Prof. Virchow too was compelled to publish a notice urgently requesting no more communications to be sent to him, for that he did not know what to do with those he had got.

Although a few links are still wanting to complete the chain of the life-history of the eel, it may be most safely assumed that the eel lays its eggs like the majority of fishes, and further, that, like the lamprey, it only spawns once and then dies. It would also seem most probable that the spawning takes place only in the sea. Eels placed in land-locked ponds, though they increase in size, never, it is well known, increase in numbers. The most important problem still to be solved is, do the male eels ever leave the sea and enter fresh water. Dr. Jacoby found male eels in the lagoons of Commachio, where the water is brackish, and these must have ascended in the mounting as fry, and then, probably, at the approach of sexual maturity, descended with the females to the sea. Dr. Hermes found some 11 per cent. of males among eels taken at Willenberg on the Elbe coast, 120 miles from the German Ocean, and no males whatever at Havelberg, twenty or thirty miles higher up the stream. Thus the numerical percentage of males to females was in proportion to the nearness to the sea.

In connection with this subject the valuable observations of Dr. Hermes on the conger, made during 1881, in the tanks of the Berlin Aquarium, may well be alluded to. Dr. Hermes found the reproductive organ in the conger very similar to those as now supposed to exist in the common eel, and in the comparison of size the relations remain the same. The male congers are much smaller than the females.

Space will not allow us to do more than refer to the journey of Dr. Jacoby in 1877, from Trieste, by way of Ravenna, to Commachio; nor to his account of the sterile females of a delicious flavour, known as Pasciuti; but we would suggest that no more satisfactory or useful work could be translated than Jacoby's "History of the Eel: with an Account of the Celebrated Eel Fishery of Commachio;" which was issued from the Berlin firm of August Herschwald, not very long ago.

## *SIR HENRY COLE, K.C.B.*

HENRY COLE, the eldest son of Captain Henry Robert Cole, was born at Bath, on July 15, 1808. On January 12, 1817, he was admitted to Christ's Hospital, where he remained until April 9, 1823. There had been some idea of sending him into the Church, but it was abandoned, and the day after he left school he commenced his career in the public service, under Mr. Cohen, afterwards Sir Francis Palgrave. His leisure at this time was spent in botanising in the neighbourhood of London; drawing under the tuition of David Cox, and contributing to the public journals. On December 28, 1833, he married his cousin, Miss Marian Bond. The public records were endangered by the burning of the Houses of Parliament in the following year. Cole worked vigorously for their preservation at the time, and was for long afterwards engaged in their arrangement. In spite of these heavy labours he had found time to commence a work on light, shade, and colour, when the prosperity of the young manager was abruptly interrupted by his summary dismissal from the Augmentation Office on December 5, 1835. He had ventured to call in question, and that in the singularly emphatic manner which characterised him through life, the competency of his official superiors, and had indicated the gross mismanagement which then obtained. It was believed that Mr. Cole's charges were unfounded, but a Committee of the House of Commons fully justified his action. He was at once reinstated in his office and advanced to be assistant keeper of the Records. At this period of his career he did yeoman's service to the cause of postal reform, and found leisure to issue, under the *nom de plume* of Felix Summerly, a series of Guide Books to Hampton Court, Canterbury, Westminster Abbey, Temple Church, the National Gallery, Free Picture Galleries, Day Excursions, Holidays spent in and near London, as well as to the various lines of Railway as they sprang into existence. Besides these he published his long-deferred "Light, Shade, and Colour," and it is one of the features of his life that he uniformly dropped a scheme which was for the time abortive, and uniformly took it up again at the relinquished point when a more propitious time arrived. He also wrote numerous works for the amusement and instruction of children in whose service he enlisted some of the most eminent artists then living. He found employment for ladies in engraving his illustrations, thus making an early attempt to solve the difficult problem of woman's work.

About this time his artistic sensibilities were shocked at the native hideousness of British manufactures, and he became a member of the Society of Arts, into the fossilised bones of which he soon instilled a new vigour. Still it was with the greatest difficulty that the leading manufacturers could be induced to co-operate. A prize competition was projected, but they dreaded to permit their names to appear, so jealous were the retail traders of their own interests. At last the show of Art Manufactures came off, and Henry Cole gained the silver medal of the Society of Arts for his "Felix Summerly" tea service. This success he followed up by a plan for the regeneration of British art applied to industry by the establishment of quinquennial exhibitions of British manufactures to commence in 1851. He commenced the issue of the *Journal of Design* to disseminate his views, and to gain information he visited the exhibition held in France in 1849. On his return he submitted his draft project to Prince Albert, by whom it was favourably received; the design grew, and expanded from a projected national exhibition to be held on the then waste ground of Leicester Square into the Great Exhibition of All Nations in Hyde Park. The conception was novel, and friends were timorous—fights hard and frequent enough to have subdued a less resolute will fell to Cole's lot—but by dint of a bull-dog refusal to be beaten, he ultimately assured the successful issue of the vast undertaking. The results gained by that success surround us on every hand in the improved taste of the country, as well in important as trivial matters. This is apparent when the manufactures of to-day are compared with those endured by our fathers.

At the conclusion of the Exhibition he had the satisfaction to see the purchase of a small collection of objects chiefly from the Indian court. These, with the drawings from the schools of design, were lodged in Marlborough House as the nucleus of a possible national art repository, which has been since realised in the South Kensington Museum.

Mr. Cole was, in 1852, appointed General Superintendent of the Department of Practical Art, which was succeeded in the following year by the Department of Science and Art, and it devolved upon him to reorganise the desultory instruction which had up to that time been afforded by the Schools of Design. How ably he, with the invaluable assistance of Mr. Richard Redgrave, R.A.,

accomplished this work, is testified by the present condition of the Schools of Art.

He was the British Commissioner for the Exposition Universelle at Paris in 1855, and on his return to England, Marlborough House being required for the use of the Prince of Wales, the collections in his custody were removed to those iron buildings which had been erected by the Commissioners of 1851, and which were commonly known by the alliterative sobriquet of the Brompton Boilers. Here, in spite of opposition and obloquy, he gradually secured the perfection of the collections, notably by the purchase after long and difficult negotiation of the Soulage collection in 1857, and the provision of adequate buildings for their reception. But he did not rest satisfied with success; as early as the year 1858 he projected a vast chorus hall, realised in the Royal Albert Hall in 1871, and the Horticultural Gardens opened in 1862. A Select Committee of the House of Commons on South Kensington, which it was thought by many would reveal a tissue of "jobbery," converted several of his opponents to a sense of the ability and integrity with which he had administered its affairs.

Though styled the Department of Science and Art, little had been done for the propagation of science prior to the year 1859. The question then arose as to the propriety of doing something to justify the title or of dropping it altogether. Mr. Cole's sympathies lay rather with the art side of the question, but he was sufficiently alive to the importance of science to urge upon the Lords of the Committee of Council the formation of a proper system of science instruction. He had the instinct which selects the right man for the right place, and found in Colonel Donnelly a colleague who ably worked out the details of that science teaching which is now going on in 1500 science schools where over 59,000 students are under instruction.

Mr. Cole next initiated the Exhibition of 1862, to the executive of which he acted throughout as general adviser, The provision of funds for the erection of the Royal Albert Hall was the next pressing question, and these General Grey, the Queen's private secretary, and he, raised by a system of subscriptions for boxes and sittings.

It was determined that South Kensington should not enjoy a monopoly of the national collections, and in 1866 the East London Museum in Bethnal Green was projected. In the following year Mr. Cole was again Commissioner for Great Britain at the Paris Exhibition, a novel feature which he introduced there being a collection of all the newspapers published in the United Kingdom. It was whilst in Paris that Sir Joseph Whitworth first discussed with him his desire to assist mechanical science by the formation of those scholarships which have since promoted the scientific education of the artisan, and rendered it possible for a young man of distinguished ability to raise himself to a position which he could scarcely else hope to attain.

Though informed in 1870 by his medical adviser of the impaired action of his heart, he did not relax his active labours; not only did he, in the following year control the first of the Annual International Exhibitions, but found time to busy himself with the disposal of the sewage of our great towns. In 1872 he received the Gold Albert Medal from the Society of Arts. After 50 years of public service, Mr. Cole retired on a full pension specially awarded by the Treasury in May, 1873. But his retirement from the South Kensington Museum certainly meant no abandonment of work. Mr. Cole founded the School for Cookery; edited an edition of T. Love Peacock's works; projected and worked out many details of a universal catalogue of printed books; worked at the sewage question as affecting Birmingham and Manchester, in which he resided from 1876 till 1879, to prosecute his work.

Mr. Cole was nominated a C.B. in 1852, and created a K.C.B. in 1875. In 1855 he was made Officer of the French Legion of Honour; in 1867 he received the Austrian Iron Crown.

Sir Henry Cole had recently been recommended caution on account of the condition of his heart, but no immediate danger was apprehended. On the day previous to his death he was engaged upon the public works that employed his time and thoughts. In the evening he became seriously ill, and died painlessly at 7.30 p.m. on Tuesday, April 18.

It is difficult to sum up the character of a man who has so recently passed away, but it may be said that his strong points were his retentive memory, his power of organisation, and his firmness of will. When all is said, he was a good and genial friend and a devoted servant of the public, and when the time comes for a history of English art education in the nineteenth century, it is not too much to say that one of the names which must stand to the fore will be that of Henry Cole.

## NOTES

ON another page we make brief allusion to the irreparable loss which science has sustained in the death of Mr. Charles Darwin on the 19th instant, in his seventy-fourth year. We hope in an early number to refer in some detail to the vast and varied work which he has accomplished during the last half century. Yesterday, as was fitting, "he was laid among his peers in Westminster Abbey."

AT Monday's meeting of the Royal Geographical Society Lord Aberdare announced that the Founder's (gold) medal had been awarded to Dr. Gustav Nachtigal for his journey through Eastern Sahara in the years 1869 to 1875; and the Patron's (gold) medal to Sir John Kirk, K.C.M.G., M.D., her Majesty's Consul-General at Zanzibar, for his long-continued and unremitting services to geography in Dr. Livingstone's Zambesi expedition in 1858-63, and in the assistance he had rendered to successive expeditions in East Africa during his fifteen years' residence in Zanzibar.

ALTHOUGH he has bequeathed most of his large fortune to the French Government for scientific purposes, M. Henry Giffard has left legacies to several scientific institutions.

FROM a *Daily News* telegram we learn that on Monday night the Eclipse Expedition arrived at Gibraltar, all well. A stiff gale and heavy sea were encountered in the Bay of Biscay, but no damage was done to the instruments.

PROF. HAECKEL has reached Egypt on his way home from Ceylon; on returning to Germany after finishing his researches in Egypt, he will publish an account of his tour.

WE regret to state that M. Eugene Frederic Kæstner, the inventor of the Electrical Thermophone, which has produced such striking effects in Germany and and in Paris, died a few days ago at Strasburg after a long illness. He was only thirty years of age. This ingenious and laborious young man was the only son of M. Frederic Kæstner, who has written a number of most interesting works on the music of nature and musical philosophy. It was only owing to the illness of M. Kœstner and his inability to do any work at all for the last few months that his wonderful instrument had not been sent to in the Electrical Exhibitions of Paris and the Crystal Palace, but it is stated that steps will be taken to send it to the Munich Exhibition.

THE second edition of Vol. I. of Thomson and Tait's "Treatise on Natural Philosophy" is now nearly completed; Part ii. being in the press and to be published very soon by the Cambridge University Press. The work has been carefully revised, and amended in many parts. The parts "On the Attraction of

Ellipsoids," and "On the Equilibrium of Rotating Liquid Masses," have been re-written, with the addition of some results of fresh investigations in the last-mentioned parts.

THERE is also now in the press, very nearly ready for publication, a volume of Mathematical and Physical Papers, by Sir William Thomson. Generally the papers are arranged according to the date of first publication, but in some cases this rule is departed from and the articles on one particular line of research brought together. Amongst the more important papers included in this volume may be noticed the series of papers "On the Dynamical Theory of Heat," published from 1851 to 1878, with the addition of one on "Thermodynamic Motivity," published in 1879. Also the joint papers by Dr. Joule and Sir William Thomson on a long series of researches on "The Thermal Effects of Fluids in Motion," which they carried out together during the years 1853 to 1862. The volume includes also papers "On the Thermodynamics of Electrolysis" and "On the Theory of Electrodynamic Machines," which has acquired so much of general interest through the extensive practical applications which have been made of it for electric lighting and the electrical transmission of power within the last ten years. Additions and annotations have been made in many parts of the volume, but the original papers are given without even verbal change. Corrections, where errors have been found, have been distinctly marked in every case, and in most cases dated. This first volume includes all of Sir William Thomson's papers published between 1841 and 1853, except those which appeared ten years ago in his volume of collected papers on "Electrostatics and Magnetism." It will be followed as speedily as possible by other volumes completing the series to the present date.

THE second volume of the "Mathematical and Physical Papers" of Prof. G. G. Stokes, is now nearly complete, and will shortly be published. A third volume is in preparation, and it is intended to complete the series as soon as possible.

JUDGING from newspaper reports and private letters which we have received, much dissatisfaction has been created in Sydney by the recent appointment of two professors to fill the chairs of natural history and of anatomy and physiology in the University; and we think there can be no question that this dissatisfaction is of only too reasonable a kind. It seems, that instead of advertising the chairs as vacant, the Senate, at an unusually small meeting, hurried through the nomination and election of the two candidates who have been chosen, with the result of obtaining for the chairs of anatomy and physiology, a gentleman who, since he left college fifteen years ago, has had no connection with anatomical or physiological work; and for the chair of natural history, an elderly gentleman who has been all his life a master of a grammar school. As the emoluments attaching to these chairs are sufficient to attract men of the highest standing from any part of the world, it is difficult to speak in strong enough terms of the conduct of the meeting of Senate at which the appointments were made; and we sincerely hope, for the sake of science as well as for that of the University, that public opinion in Sydney may prove strong enough to prevent the recurrence of any such—to use the mildest term—mi-guided policy.

THE South-Eastern Railway Company have withdrawn their opposition to the underground electric railway, which it is proposed to construct from Charing Cross, at a point near the north-west end of Northumberland Avenue, passing under the River Thames, and terminating at Vine Street, under the loop-line station of the Waterloo terminus of the London and South-Western Railway. The Parliamentary Committee have passed the bill.

THE French Government is making preparations to send out an Antarctic expedition to Cape Horn. M. Mascart, the head of the Bureau Central, has been communicated with, for the appointment of meteorological and magnetical observers. The expedition will be fitted out for a period of eighteen months, and 2½ million francs have been voted for it.

BY authorisation of the Russian Minister of Public Instruction, the Imperial University of St. Petersburg is about to found an astronomical observatory, which will be of small size conformably to its principal object, which is to facilitate the studies of those who are engaged in the University curriculum. The principal pieces forming the *matériel* will be two refractors, with Merz object-glasses, one 6 inches aperture, the other 4 inches, parallactic mounting and clockwork motion, several transportable astronomical instruments, and an astronomical clock with some other secondary instruments.

WE take the following from the *Photographic News*:—"They are going to try a strange experiment in Paris. The idea is to combine amusement with scientific instruction, by producing at one of the theatres a series of scientific dramas. The Folies Dramatiques is the theatre chosen for the purpose, and the experiment is to commence during the summer months. Already three plays have been provided for this bold scheme, and their titles indicate plainly in what direction the audience is to be instructed. The first drama is called 'Denis Pepin, or the Invention of Steam'; the second is entitled 'Kepler, or Astronomy and the Astrologer'; and the third is 'Gütenberg, or the Invention of Printing.' We would suggest yet another title: 'The Triumvirate—Niepce, Daguere, Talbot—or the Invention of Photography.'"

AT a recent meeting of the Seismological Society of Japan, Prof. Milne read a paper on the "Distribution of Seismic Activity in Japan." This paper was to a great extent founded on communications received from almost all parts of Japan in answer to inquiries respecting the occurrence of earthquakes in various districts. As the result of these inquiries during the past two years, Mr. Milne had received, in addition to general opinions respecting the seismic activity of various districts, a very large number of actual records. Commencing in the north and proceeding to the south, notes and catalogues of earthquake intensity for the whole country were given. Thus for Hakodate, in Yezo, from 1876 to 1880 a catalogue of forty-two earthquakes was given. By comparing this catalogue with that of Sapporo, in the same island, it was seen that ten at least of the Hakodate shocks had been felt at Sapporo, eighty miles to the north-east; and similarly it was shown that seven of the shocks were felt at Tokio, five hundred miles to the south. From the times at which a shock was felt in different localities, its intensity and the like, origins for certain shocks were roughly computed. The district around Tokio is of course that which is being most thoroughly investigated; and as it was only possible to obtain *accurate* observations as to the time at which shocks were felt at one or two localities, and farther, as it was shown that the direction in which the earth moved at any given point as indicated by a seismometer did not necessarily indicate the direction from which the earth waves were advancing, Mr. Milne has adopted the following simple method as an assistance in tracing earthquakes to their origins. All important towns within a radius of one hundred miles from Tokio have been furnished with bundles of post-cards, one of which is posted every week stating whether earthquakes have or have not been felt. In this way, at the end of last year, Mr. Milne found that the greater number of the earthquakes which were felt in Tokio had only been felt in the towns to the north of that city, and a short distance to the south. This fact being established the barrier of post-cards was continued about two hundred miles still farther north, with the result of inclosing, so to speak, the origin of several shocks, and tracing others to the sea-shore. The latter could no longer be pursued by means of post-cards, and instru-

mental observations alone had to be relied on for the determination of their origin. These observations, so far as they have at present gone, show in a remarkable manner how a large mountain range absorbs earthquake energy. Thus, it is very seldom that an earthquake travelling from the north passes beyond the Hakone range of mountains to the south of Tokio. Earthquakes having their origin on either side of such a range rarely travel to the other side, however large their area of activity on their own side may be. The whole of Japan has in this way been divided into districts of varying seismic activities. By two separate systems of investigation Mr. Milne showed that, if instruments of ordinary sensitiveness were distributed throughout Japan there would on the average be recorded, at the lowest estimate, over 1200 shocks per year, or about three shocks per day, which is a number greater than that obtained by Prof. Hein for the whole world.

THE last number of the *Journal* of the North China branch of the Royal Asiatic Society contains a long and learned paper by Dr. Bretschneider, of the Russian Legation at Pekin, on Chinese Botany. The plan of the work, of which the present is only an instalment, is explained as follows. It is divided into a general and a particular part. The first, which forms the substance of the present paper, begins with a review of the history of botany, agriculture, and Materia Medica of the Chinese and other Eastern Asiatic nations, and enters into some details concerning the most prominent treatises and authors in these departments. In the same chapter he shows the method employed by the Chinese in describing plants and in investigating botany and materia medica. Another chapter is devoted to the important question of identifying Chinese names of plants with the scientific botanical names, and to recording the attempts made by European scholars to ascertain the botanical names of the plants described in Chinese books. The first part will conclude with an alphabetical list of Chinese works, and another of Chinese authors quoted in native botanical treatises. In the second part, the author will give a history of Chinese domestic, ornamental, medicinal, and other plants used for economic purposes, as far as these have come to the knowledge of botanists. The work, it will thus be seen, involves a vast amount of laborious research in European as well as Chinese literature. The present number contains chapters on the history of the development of botanical knowledge among the various peoples of Eastern Asia, and on the scientific determination of the plants mentioned in Chinese works, together with an index of Chinese writers on botany, and an appendix on celebrated mountains in China, which are frequently mentioned in Chinese botanical works. Dr. Guppy, R.N., gives some notes on the hydrology of the Yangtsze, Yellow River, and Peiho, and also on the geology of Takow in Formosa. The other paper is by Father Dechevrens, S.J., on the climate of Shanghai. The number closes with a list of the ferns found in the valley of the Foochow River.

THE fourth number of the *Memoirs* of the Science Department of the University of Tokio is a monograph on the geology of the environs of Tokio, by Prof. Brauns; while the fifth contains a paper by Prof. Mendenhall on the force of gravity at Tokio and on the summit of Fujiyama. Dr. Naumann, the head of the Japanese Geological Survey, has recently published a monograph on Japanese elephants. The writer has found remains of these mammals in various widely separated districts. This paper will be found in vol. xxviii. of the "Palæontographica," published by Fischer of Cassel, and is entitled "Ueber Japanische Elephanten der Vorzeit."

IN the Belgian Academy, M. Plateau has lately called attention to a small illusion. He describes an arrangement which, at first sight, he says, might be thought capable of realising perpetual motion. A capillary tube is inserted obliquely in distilled water, so that the latter nearly fills it. Into this liquid column, at the top, dips the small orifice of another tube, which reaches a little way in the same oblique direction, then turns downwards, the vertical portion being wider, and not reaching the water. Suppose this bent tube filled with water. It then forms a siphon, the shorter branch of which is immersed in a liquid in equilibrium, while the longer descends several centimetres below the surface of that liquid. Does it not appear as though the water should flow incessantly through the siphon, and, regaining the vessel, be engaged in perpetual circulation? As a matter of fact, the water is drawn upwards in the vertical portion of tube till its free surface reaches a part of the oblique part of the same tube, when it stops. M. Plateau accounts for the effects by suction exerted by the small concave liquid surface between the two tubes.

A NEW dynamo-electric machine, recently brought before the Belgian Academy by M. Plücker, has the peculiarity that a solenoid is substituted for the electromagnet as an organ for excitation of the induction currents. The horizontal coils of the solenoid, which is of special form, are traversed by the currents produced by the machine itself. The apparatus rotated within the solenoid is a wheel with coils arranged nearly like those of the Gramme ring. The whole system is inclosed in an iron armature meant to increase the inductive action. M. Plücker states that he replaced the solenoid with electromagnets, and the apparatus produced the same effect. He seems merely to claim the advantage of less weight and volume.

A SERIOUS difficulty recently occurred at Berlin, in connection with a system of supply of "ground water" by "natural filtration" (a part of the Berlin water supply having been taken since 1877 from near the Tegeler Lake, by means of a series of twenty-three wells running parallel with the shore; the water was pumped into a small covered reservoir, then to another at Charlottenburg, 6 or 7 kilom. distant, whence pumps supply the city). Complaints arose on account of the water, though clear at first, getting turbid ere long, and depositing an ochreous sediment found to consist of amorphous hydrated oxide of iron, but also very largely of algæ, dead and alive; *Crenothrix kühniana* (a plant of thready form), being most noticeable. The source of the plants could neither be located in surface-water, nor in the neighbouring lake; and there is reason to believe the plant lives and grows in the ground itself. After sundry attempted remedies it seemed that artificial filtration would be necessary. It was found that water brought directly from the wells to the filter, gave, after filtration and rest, the usual deposit. But by exposing this well-water to the air, so that all the iron was oxidised and deposited before filtration, it was possible to get a filtered water which remained clear; though it is not known whether this filtered water was really free of spores, and would continue clear after being in contact with the iron of the service. Iron seems essential to the existence of *Crenothrix*, and is proved to be present in its threads. The filter-sand was very much fouled, and, because of the difficulty of keeping out spores, it was thought best to abandon the wells altogether, and to use water taken directly from the lakes and filtered in the usual way. Prof. Nichols (who reports these facts in the Franklin Institute *Journal*) refers to somewhat similar troubles having been experienced at Halle, and at a town in the east of Massachusetts.

THE following subjects are announced by the Belgian Academy for prize competition:—In mathematical and physical sciences: Establish, by new experiments, the theory of reactions of bodies in the so-called nascent state. Prove the accuracy or falsity of the following proposition by Fermat: To decompose a cube into two other cubes, a fourth power, and generally any power into two powers of the same name, above the second power, is im-

possible. New spectroscopic researches required as to whether, especially, the sun does or does not contain the essential constituent principles of organic compounds. Extend, as much as possible, the the theories of points and straight lines of Steiner, Kirkman, Cayley, Salmon, Hesse, and Bauer, to the properties which are, for superior plane curves, for surfaces, and for skew curves, the analogues of theorems of Pascal and Brianchon. In natural sciences: New researches required on germination of seeds, especially on assimilation of nutritive stores by the embryos New researches required on development of Trematodes, from the histogenic and organogenic points of view. New stratigraphical, lithological, and palæontological researches required, to fix the arrangement or the order of succession of layers of the formation called Ardennais by Dumont, and at present considered a Cambrian. Medals valued at 800 francs will be given as prizes in the first division; medals of 600 francs in the second. Memoirs may be written in French, Dutch, or Latin, and should be sent (in the usual form) to the Secretary, before August 1, 1883.

THE number of large carnivorous animals killed in Algeria is diminishing yearly with great rapidity. In 1879 the Government paid for 166 heads of lions and panthers; and in 1880 only for 128, viz. 16 lions, 100 adult panthers, and 16 young. It is certain that in a very few years they will be entirely extirpated. They are now very seldom met with, except in some mountainous parts, and almost wholly deserted districts of Constantine province. When the conquest was made, they were occasionally seen at the gates of Algiers, and so frequently on the sea-coast, that a cape near Arzav received the name of "La Montagne des Lions," which it has retained.

THE electrical perturbations were so frequent on the French lines from April 16 to 20, that measures had to be taken by the Minister of Postal Telegraphy to meet this contingency. The electrical equilibrium was restored on the 21st. These electrical perturbations were noticed on the telegraphic lines of Germany, Belgium, and Italy, and of England, according to the notice which was published by the French Administration in the official paper of the Government.

A SLIGHT earthquake shock was felt at Geneva on Thursday, and a smart one on the previous Monday in the Vaudois and Jura. On both these days the telegraphic wires here were affected, which produced a violent oscillation of the needles. Similar perturbations were observed at other stations. A violent earthquake is reported from Syra (Greece). The shocks lasted nearly a minute, yet but little damage was done. On the Ætolian coast the sea has still its blood-red colour, and the smell of sulphuretted hydrogen becomes more and more intense.

THE *Daily News* Naples Correspondent writes on the 21st:—"The central crater of Mount Etna has been throwing up ashes for the last two or three days, covering the pure new snow lately fallen with a stratum of black ashes on the south-east side. The mud eruption at Paterna continues, but is limited to one crater, from which flows hot and liquid mud."

THOSE interested in the very wide region included in "the East," will find the "Bibliotheca Orientalis," published by Trübner and Co., very useful. It is stated to be a complete list of books, papers, serials, and essays published in 1881 in England and the Colonies, Germany, and France, on the History, Languages, Religions, Antiquities, and Literature of the East, compiled by Charles Friederici. This is the sixth year of publication.

A SIMPLE new thermometer, said to be very sensitive, has been described (*Jour. de Phys.*, April) by Mr. Michelson. It depends on the expansion of hardened caoutchouc by heat. A very thin strip of the substance is attached to a similar strip of copper. The lower end of the double strip is fixed, and the other has attached to it a fine glass fibre bent at a right angle, through which, as the strip bends under heat, motion is imparted to a very light silvered-glass mirror, hung by a cocoon fibre. The displacement of the mirror is observed with a telescope and reflected scale, or by the movement of a spot of light. To avoid sudden changes of temperature, the double strip is inclosed in a metallic case having a slit opposite the strip. In a modification, which the author has not yet tried, the strip is reversed, and the lower end enters a highly resistant liquid, in which it faces a metallic point; the two serve as electrodes, connected with a galvanometer and a Wheatstone bridge.

AT the thirteenth annual meeting of the Norfolk and Norwich Naturalists' Society, the president stated that during the session which was past, a considerable number of papers had been read and specimens exhibited, which were not of interest to scientific people only. The popular taste demanded something beyond that. The society had endeavoured to meet this requirement. The number and strength of the Naturalists' Society grows with its years. At the last annual meeting the society numbered 202 members; the number now reached is 234. A very good feature has been the formation of a naturalists' library. The concluding portion of the address was occupied with a survey of certain features in the Ornithology of Norfolk at the present day, some of which were a cause of congratulation and others of regret. As, for instance, the short-eared owl, which had for some years ceased to be a resident species in Norfolk, had again been known to nest and rear its young in both divisions of the county; and the hawfinch seemed yearly to increase in favourable localities.

ONE more American serial comes to us in the shape of the Scientific *Proceedings* of the Ohio Mechanics' Institute, containing a number of papers of practical importance, including a long one on Economy of Fuel, by Mr. N. W. Perry.

WE have on our Table the following books:—Volumetric Analysis, 4th edition, by F. Sutton (Churchill and Co.); A Manual of Botany, 4th edition, by R. Bentley (Churchill); Permanence and Evolution, by S. E. B. Bouverie-Pusey (Kegan Paul); Annuaire de l'Academie Royale de Belgique (1882, Brussels); Observations on Cup-shaped and other Lapidarian Sculptures in the Old World and in America, by Charles Rau (Washington); Vibratory Motion and Sound, by Prof. J. D. Everett (Longman); Microscopical Section Cutting, by Sylvester Marsh (Churchill); The Fishes of Great Britain and Ireland, by Francis Day (Williams and Norgate); The Scientific Bases of National Progress, by J. Gore, F.R.S. (Williams and Norgate); Jamaica Institute Lectures, 1881 (Kingston, Jamaica); The Butterflies of Europe, Part vii., by H. C. Lang (Reeve and Co.); A Visit to Madeira, by Dennis Embleton, M.D. (Churchill); Religion and Philosophy in Germany, by Heinrich Heine, translated by John Snodgrass (Trübner); A Monograph of the British Fossil Cephalopoda, Part i. by J. F. Blake (Van Voorst); Elementary Physiology, by A. Findlater (Chambers); Vital Statistics: Small Pox and Vaccination, by Dr. C. T. Pearce; (E. W. Allen); A Manual of the Geology of India, by V. Ball (Calcutta); Rivers and Canals, 2 vols., by L. F. V. Harcourt (Clarendon Press); The Sphygmograph, by Dr. Dudgeon (Baillière, Tindall, and Co.; On Failure of Brain Power, by Dr. Julius Althaus (Longmans); Plane Geometrical Drawing, by F. E. Hulme F.S.A. (Longmans); The Action of Lightning, by Major Parnell, R.E. (Lockwood); Beauty, and the Laws Governing its Development, by Joseph Hands (E. W. Allen); New Views of Matter, Life, Motion, and Resistance, by Joseph Hands (E. W. Allen); Astronomical Observations made at Dunsink, Part 4 (Hodges, Foster, and Co.); Houses and Farms in America, by Dr. G. H. Everett (C. Dickie); Modern Metrology, by L. D'A. Jackson

(Lockwood); The Coming Transit of Venus, by William Peck (R. Symon); The Horse in Motion, by J. B. D. Stillman (Trübner); Bibliotheca Orientalis, by C. Friederici (Trübner); Contributions to the History of the Development of the Human Race, by Geiger (Trübner).

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♀) from India, presented by Mr. W. T. Fremlin; a Two-spotted Paradoxure (*Nandinia binotata*) from West Africa, presented by Mr. A. N. Blyth; a Rufous Rat Kangaroo (*Hypsiprymnus rufescens* ♀) from Australia, presented by Mr. C. Caravossi; two Cockateels (*Calopsitta novæ-hollandiæ* ♂ ♀) from Australia, presented by Mr. W. C. Atkinson; a Common Raven (*Corvus corax*), British, presented by Mr. H. E. Langton; a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Mrs. Ramsay; a Lanner Falcon (*Falco lanarius*), from East Europe, presented by Mr. J. E. Harting, F.Z.S.; a Common Night Heron (*Nycticorax griseus*), European, presented by Mr. H. D. Compton; a Lesser White-nosed Monkey (*Cercopithecus petaurista* ♂) from West Africa, a Cabot's Horned Tragopan (*Ceriornis caboti* ♂), from South-West China, deposited; a Silvery Gibbon (*Hylobates leuciscus*) from Java, a Mongoose Lemur (*Lemur mongoz* ♂), a Red-fronted Lemur (*Lemur rufifrons* ♂), two Grey-headed Love Birds (*Agapornis cana* ♀ ♀) from Madagascar, a Squirrel Monkey (*Chrysothrix sciurea*), a —— Squirrel Monkey (*Chrysothrix*, sp. inc.) from Guiana, two Rufous-tailed Pheasants (*Euplocamus erythropthalmus* ♂ ♀) from Malacca, a Wheatear (*Saxicola œnanthe*), a Meadow Pipit (*Anthus pratensis*), a Redstart (*Phœnicura ruticilla*), British, a Burchell's Zebra (*Equus burchelli* ♂) from South Africa, purchased; an Eland (*Oreas canna* ♂), two Short-headed Phalangers (*Belideus breviceps*), a Squirrel-like Phalanger (*Belideus sciureus*), four Slender Ducks (*Anas gibberifrons*), two Common Cormorants (*Phalacrocorax carbo*), bred in the Gardens.

## OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF TRINITY COLLEGE, DUBLIN.—The fourth part of "Astronomical Observations and Researches made at Dunsink" has just appeared under the editorship of Mr. J. L. E. Dreyer. It contains the results of about 1140 observations of 321 red stars, chiefly taken from Schjellerup's Catalogue, made with the meridian-circle of the Dunsink Observatory, the object-glass of which has an aperture of 6·38 inches, the instrument being the work of Piston and Martins of Berlin. The observations were commenced by Dr. Copeland in July, 1875, and continued by him up to the end of March, 1876. Mr. Dreyer commenced observations in September, 1878, and the series was finished in November, 1880. As far as possible, it has been the object to secure four complete observations of each star. The separate results are printed, with the corresponding dates and estimates of the magnitudes of the stars which have a particular interest from the fact of so many of the red stars being variable. The Dublin observations show this to be the case in a striking degree, and not only is there variation in the brightness of many of the objects, but it is hardly possible to doubt that they establish changes of colour from time to time in some of the stars. Thus we find No. 5 (Schjellerup) was *white* on November 14, 1875, and *deep orange* three months later. No. 143 was considered *orange* on February 28, 1876, but showed *no colour* on March 19; in March, 1880, it was again orange. No. 186 had no colour on April 30, 1880, but was deep orange on June 10 following; and there are a number of similar cases, too many, it would appear, to allow of their being attributable to varying conditions of atmosphere.

The observed positions of the 321 stars are formed into a general Catalogue for 1875·0, with the corresponding precessions, which will have much value in the study of the proper motions of the red stars.

THE OBSERVATORY OF MOSCOW.—Prof. Bredichin has issued the first part of vol. viii. of *Annales de l'Observatoire de Moscou*, which in addition to meridian observations, contains a continuation of his researches upon the tails of comets, the present publication including the comets 1881 *b* and *c*, and the fourth or great comet of 1825. Prof. Bredichin has reprinted the long series of physical observations on the latter body made by Dunlop at Paramatta N.S.W., which originally appeared in Brewster's *Edinburgh Journal of Science*, 1827, and which have been a good deal overlooked, that periodical, on the continent at least, not being easy of access. Dunlop's drawings are reproduced, and there are several figures of the two bright comets of 1881. With regard to his investigations generally, Prof. Bredichin concludes: "Mes recherches sur toutes les Comètes, dont les observations j'ai pu trouver dans la littérature astronomique (36 comètes) me mettent maintenant en état de calculer d'avance pour chaque grande Comète qui paraîtrait les positions et la figure de ses queues de tous les trois types. Il est evident que la quantité rélative des substances caudales de différents types ne peut pas être déterminée d'avance, et par conséquent c'est seulement l'observation qui pourra nous montrer et la clarté rélative des types et l'absence possible de tel ou tel d'entre eux. Mais en tout cas, les positions et la forme générale de celle des queues, qui deviandra, accessible à la vision, seront en accord avec ses positions et sa figure calculées d'avance."

THE PRESENT COMET.—The following positions for Greenwich midnight are from the elements published last week. On April 16 the calculated place was in error −7s. in R.A. and −2′ in declination, but the errors will be increasing.

| | R.A. h. m. | Decl. ° ′ | Log. distance from Earth. | Sun. |
|---|---|---|---|---|
| May 2 ... | 20 52·4 ... | +69 53 ... | 9·9904 ... | 0·0793 |
| 4 ... | 21 22·6 ... | 71 40 ... | 9·9818 ... | 0·0632 |
| 6 ... | 21 59·5 ... | 73 9 ... | 9·9740 ... | 0·0461 |
| 8 ... | 22 43·4 .. | 74 10 ... | 9·9671 ... | 0·0280 |
| 10 ... | 23 32 8 ... | +74 35 ... | 9·9610 ... | 0·0087 |

The perihelion distance in the orbit referred to which depends on observations to April 6 is 0·0560; M. Bigourdan, from observations at Paris to April 11, finds it 0·0602.

## GEOTROPISM AND GROWTH[1]

IF the *punctum vegetationis* of a root is removed by a transverse section, the root loses more or less completely the power of curving geotropically downwards when placed in a horizontal position. This curious experiment was originally made by Ciesielski, and has been confirmed by the observations described in "The Power of Movement in Plants" (chap. xi.). The theory founded by Mr. Darwin in these observations is that the *punctum veg.* is the part of the root which is sensitive to gravitation, and that a stimulus is thence transmitted to the region of growth where the geotropic curvature takes place. But it is evident that the facts are capable of a different interpretation, it might be supposed that cutting off the tip of the root acts merely as a shock, and prevents the occurrence of geotropism, just as any other severe injury might do so. This view has recently been brought forward by Wiesner ("Das Bewegungsvermögen der Pflanzen," 1881, p. 97), and is supported by him with a number of experiments on the growth of decapitated roots. The results of some of Wiesner's experiments are given below, the figures representing the amount of growth per cent. in twenty-four hours:—

Maize.

| Normal Roots. | | Decapitated Roots. | |
|---|---|---|---|
| 77·5 | ... | 41 | or as 100 : 52·9 |

Peas.

| | | | |
|---|---|---|---|
| 42·7 | ... | 9·7 | ,, 100 : 22·7 |

*Vicia Faba.*

| | | | |
|---|---|---|---|
| 90 | ... | 60 | ,, 100 : 66·6 |

Wiesner believes that this difference in growth between the normal roots and those of which tips had been cut off is sufficient to account for the disturbance in geotropism. It should be added that in Wiesner's experiments geotropism was not so completely checked by cutting off the tips of the roots as in those given in the "Movements of Plants."

In the present paper the intervals of time between the observations on the rate of growth were shorter than in Wiesner's experiments—namely, about three hours instead of twenty-four hours; the reason for this difference being that geotropic curva-

[1] A paper read before the Linnean Society, April 6, by Mr. Francis Darwin.

tures generally take place long before twenty-four hours have elapsed.

Dots were made on the roots (*Vicia Faba*) at different distances from their tips, so that the spaces thus marked out could be measured by means of a microscope. The beans were placed during the experiment in closely-shutting tin boxes, nearly filled with damp peat.

A considerable number of experiments were thus made, and the results obtained do not confirm those of Wiesner, but agree rather with Sachs' statement, that cutting off the tip of a bean root does not seriously hinder its growth. They show, moreover, that the effect of the operation is transitory, and that as the roots recover from the shock, they may actually grow more quickly than the uninjured specimens. Thus in one of the experiments the roots were marked at 2 mm. and 5 mm. from the apex, and the intervening space was measured after 3h. 10m., and again an additional interval of 3h. 5m. During the first 3h. 10m., if the growth of the normal roots be taken as equal to 100, that of the "cut" ones was 78; during the second period the proportion was :—normal to "cut" as 100 to 102; that is to say, the "cut" roots grew more quickly than the uninjured ones.

Other experiments gave the same result; on the other hand some cases occurred in which the power of recovery was not so rapid or well marked. Thus in one experiment the growths (per cent.) after twelve hours were in the proportion:—Normal : Cut : : 100 : 83, so that the growth of the "cut" roots was less by 17 per cent. than that of the uninjured ones.

On the whole the experiments show distinctly that a loss of geotropism may occur without serious interference with growth. The author then goes on to show that even if this were not so, it could still be shown that Wiesner's conclusion is incorrect.

If a root is split by two longitudinal incisions into three lamellæ, and if it be placed horizontally, so that the cut-surfaces are in a vertical plane, Sachs has shown that the central portion of the root containing the chief part of the vascular tissue, is capable of bending geotropically downwards. It was therefore thought desirable to compare the rates of growth of such split roots with others whose tips had been cut off. The result showed that the "cut" roots grow much more vigorously than the split ones. Thus we have in one experiment—

Cut : split : : 100 : 68·7.

In another—Cut : split : : 100 : 67·4.

Yet here the only clear geotropism that took place was among the split roots.

Thus Wiesner's argument falls to the ground, for, if retarded growth were the cause of "cut" roots being less geotropic than uninjured ones, it is clear that "split" ought to be even less geotropic than the "cut" roots, instead of exactly the reverse of this being the case.

The results here given are of some general interest, as showing, that although geotropism is a phenomenon of growth, it need not necessarily be subject to strictly the same conditions as undisturbed growth.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—The following lectures on natural science are being given this term ;—

Chemistry and Physics : Prof. Liveing on General Principles of Chemistry ; Mr. Sell (Demonstrator), Elementary Chemistry ; General Course, Mr. Main, St. John's College ; Organic Chemistry, Mr. P. Muir, Caius College ; Sound, Mr. Trotter, Trinity College ; Electricity and Magnetism, Mr. Garnett, St. John's College ; Papers on Elementary Physics, Mr. Shaw, Emmanuel College ; Elementary Optics and Electricity, Mr. Glazebrook, Trinity College ; Crystallography, Prof. Lewis ; Physics (advanced), Mr. Garnett, St. John's College ; Advanced Demonstrations on Light, Elasticity, and Sound, will be given by Mr. Glazebrook, and Mr. Shaw will give elementary demonstrations on Optics and Electricity, both in the Cavendish Laboratory. Practical Chemistry, in the University, St. John's, and Caius College Laboratories.

Biology :—Elementary, Dr. Michael Foster ; Advanced Physiology, Mr. Langley ; Physiology of Respiration and Animal Heat, Dr. Gaskell ; the Eye and Vision, Mr. Lea ; Physiology, for Tripos and 2nd M.B., Mr. Hill, Downing College ; Human Anatomy, Demonstrations for Tripos students, Dr. Creighton ; Mechanics of Human Skeleton, Mr. McAlister, at old Anatomical School ; Mr. Sedgwick, Embryology of Mammals and Birds, in Mr. Balfour's Laboratory, followed by practical work ; Advanced Course on Mammalia, by the Demonstrator of Comparative Anatomy at New Museums. In Botany, Prof. Babington will lecture on Morphology and Classification ; Dr. Vines, on Morphology, chiefly Cryptogamic, with practical work, at Christ's College ; Mr. Saunders, on Histology, at Downing College, Mr. Hicks, Sidney College, papers in Elementary Botany. Mr. Vines is also giving an elementary course of lectures on General Physiology and Life History of Typical Plants, in the Botanical Lecture Room, New Museum.

Geology :—Prof. Hughes, Stratigraphical Geology, the district around Cambridge ; Fossil Echinids and Corals, and also Petrology, Mr. Tawney ; Elementary Geology, Dr. Roberts ; Class Work, Mr. Marr ; Field Lectures, Prof. Hughes.

The Demonstrator of Mechanism is lecturing on Applied Mechanics at the Museum of Mechanism ; and the workshops and drawing office are open for practical work.

Prof. Stokes is lecturing on Optics.

C. N. Adams (Exeter School) and S. Skinner (Dulwich College) have been recommended for Natural Science Open Scholarships at Christ's College.

At Newnham College Mr. Garnett is lecturing on Dynamics, Miss Scott on Integral Calculus, and Miss Harland on Euclid and Algebra.

THE Spring Session of the Royal Agricultural College, Cirencester, ended on Wednesday, 19th inst., when the diploma, certificates, and prizes were distributed to the successful candidates by Prof. Nevil Story-Maskelyne, M.P., who has been recently elected to the Council of the College. Mr. Maskelyne, in his address to the students, pointed out the great value of a study of the lower organisms, and the immense influence which these have on the pursuit of agriculture, as is seen in the process of nitrification, the changes taking place in milk, in cheese, and the like.

At St. John's College, L. J. Fuller has been elected to a Natural Science Exhibition.

At Trinity College W. B. Ransom (2nd year) has been elected to a Foundation Scholarship ; H. Wilson Fox, H. Head, M. Miley, G. P. Bidder, and W. Gordon, to Exhibitions ; and J. R. Green to a Foundation Sizorship ; all for Natural Science.

EDINBURGH.—Prof. James Cossar Ewart, M.D., has been appointed to the Chair of Natural History in Edinburgh University, vacant by the resignation of Prof. Ray Lankester. Prof. Ewart at present holds the corresponding chair in the University of Aberdeen.

## *SCIENTIFIC SERIALS*

WE have received Nos. 44, 45, and 46 of the *Scottish Naturalist*. The papers on Scotch botany and zoology continue to be of great interest ; and to these are added an occasional one on Scotch geology. No. 46 (April) contains a report of an interesting lecture, by Prof. Traill, on "The Modes of Dispersion of the Seeds of Scottish Wild Plants."

*Journal of the Franklin Institute*, March.—A new theory of the suspension system with stiffening truss (continued), by A. J. Du Bois. The adhesion of flat driving belts, by R. Grimshaw. —Car-journal boxes, with Wendell's latest improvement, by C. H. Roney.—Thompson's patent wet pulveriser, by the same.—A new method of determining phosphoric acid, by H. Pemberton, jun.—The analysis of iron ores containing both phosphoric and titanic acids, by T. M. Drown and P. W. Shimer. The condition of sulphur in coal and its relations to coking, by T. M. Drown.—Natural filtration at Berlin, by W. R. Nichols.—Silk culture in the United States, by L. Blodget.

*Bulletin de l'Academie Royale des Sciences de Belgique*, No. 1, 1882.—On a sure astronomical criterion of the existence of a fluid layer within the terrestrial crust, by M. Folie.—A small illusion, by M. Plateau.—New observations of the effects of lightning on trees placed near a telegraph wire, by M. Montigny. —Influence of respiration on the circulation (third paper), by M. Fredericq.—On a method of determination of latitude, by M. Adam.—Researches on the dialysis of arable soils, by M. Petermann.—On the excretory apparatus of rhabdocœl and dendrocœl Turbellarians, by M. Francotta.—New parasitic worms of *Uromastix acanthinurus*, by M. Fraipont.—Dynamo-electric

machine with inductor-solenoid and continuous current, by M. Plücker.—Reports, &c.

No. 2.—Determinism and liberty; liberty demonstrated by mechanics, by M. Delbœuf.—On the origin of the Devonian limestones of Belgium, by M. Dewalque.—On the zircon of the quarries of Nil St. Vincent, by M. Renard.—On monochlorised chloride of acetyl, by M. Krutwig.—Influence of respiration on the circulation (fourth paper), by M. Fredericq.—Funeral discourses on M. Schwann and Col. Aden.—Reports, &c.

*Archives des Sciences Physiques et Naturelles*, March.—Influence of physico-chemical media on living beings; influence of different kinds of food on the development of the frog, by I. Yung.—Disinfections with sulphurous anhydride; siphonoid apparatus with special *transvaseur*; description of apparatus and management, by V. Fatio.—Swiss geological review for 1881 (continued), by E. Favre.

*Révue d'Anthropologie*, tome v., fasc. 1, 1882.—M. Paul Topinard's paper, on the weight of the brain, gives a comprehensive summary of all that had been done by Broca in this branch of craniology since the foundation of the mother-society at Paris, in 1861. Broca's tables, including upwards of 1000 of his own observations, were being revised by himself at the time of his death, and these, the further revision of which has been intrusted to M. Topinard, are given at length, together with his own emendations, from which he has been led to conclude that excessive weight of the brain cannot, *primâ facie*, be accepted as an evidence of great intellectuality, but may fairly be assumed to depend upon some cerebral abnormality. Thus he is of opinion, that even in the case of Cuvier's brain, whose exceptionally large weight (1829 grammes) has long made it rank among cerebral marvels, the well-attested presence of hydrocephalus during the infancy of the great naturalist was not without influence on the subsequent cranial enlargement. Finally, he believes that we are justified in assuming that a well organised brain will not *very largely* exceed the mean, having due reference to age, sex, and stature. From Broca's tables we obtain a cerebral mean of 1325 for men generally, and of 1142 for women generally; the greatest weight among the former being attained between the ages of thirty and thirty-five, and among the latter, somewhat earlier. After the age of fifty-five, the diminution is rapid, and at the age of eighty it has reached the mean of 100 grammes, although the loss sometimes amounts to 250 grammes. The means for the prime of life are 1421 for men, and 1269 for women. In considering the data generally, it is essential to bear in mind that the individuals under observation were of necessity derived from the less favourable class supplied by asylums and hospitals, and, therefore, presenting generally traces of disease, more especially of the brain, La Salpetrière and Bicêtre having yielded the greater number of the brains, commented on by Broca. The great desideratum of modern cerebral inquiry is the careful determination of the difference of the weight of the brain among mentally sound individuals belonging to the two distinct classes of those who are engaged in intellectual pursuits, and those whose vocations demand great muscular activity. Broca considered that form was more important than weight in estimating intellectual capacity, which possibly depends upon qualitative, and perhaps chemically inappreciable, rather than mere quantitative, relations.—M. Topinard, in a paper on the cephalic index, as determined according to Broca's method on the living subject, and after death explains the grounds on which he, in harmony with Prof. Vogt, has been led to consider as unnecessary and even erroneous, the reduction which it has hitherto been thought imperative to make, in order to bring the cephalometric estimate into complete accord with the craniometric determinations. He believes we ought to compare the two without making any reduction.—The capacity of the Black African races for becoming acclimatised, which is treated at great length by Dr. A. Corre, forms the subject of the only other original article in the *Révue*. The author, whose views are based upon observations made during many years residence in Senegal and other African inter-tropical regions, regards the African blacks as destined from the inherent inferiority of the race to give place in course of time to European immigrants. Beyond the possession of immunity against yellow fever and certain forms of marsh fever, he considers them to be inferior to whites in their powers of resistance against disease and general climatic conditions, and consequently inapt for military service, or for the purposes of colonisation, while finally he believes that the inaptitude of the negro for every high form of sociological development is such that there is only one of two things to be anticipated in regard to the lands occupied by the black races, viz. that where the latter are the masters, barbarism will prevail, and that where they fall into subjection to civilised peoples, their numbers will gradually, but surely diminish, in spite of the more favourable conditions in which they will be placed.

## SOCIETIES AND ACADEMIES

### LONDON

**Geological Society**, April 5.—J. W. Hulke, F.R.S., President, in the chair.—W. J. H. Mylne was elected a Fellow, and M. Alphonse Milne-Edwards, of Paris, a Foreign Correspondent of the Society.—Geological age of the Taconic system, by Prof. J. D. Dana, F.M.G.S. The author takes exception to some remarks made before the Geological Society by Dr. T. Sterry Hunt on November 16 last. Dr. Sterry Hunt has thrown doubt on the results arrived at by the geologists who have studied the relations of the so-called Taconic strata, not in consequence of any observations of his own, but on the general ground that "where newer strata are in unconformable contact with older ones, the effect of lateral movements of compression, involving the two series, is generally to cause the newer and more yielding strata to dip towards, and even beneath the edge of the older rock—a result due to folds, often with inversion, sometimes passing into faults." It was pointed out in opposition to these views, that the observations of Emmons, H. D. and W. B. Rogers, Mather, Sir W. Logan, James Hall, E. Hitchcock, C. H. Hitchcock, Hager, and Wing, prove that the Taconic schists and limestones are in conformable succession and of Silurian age. The stratigraphical structure of the Taconic range is, indeed, so simple that all observers who have studied it have described the schists and limestones as conformable; and numerous characteristic Silurian fossils have been found in both. This view had been maintained by Dr. Sterry Hunt himself till 1878, when he first propounded his new interpretation of the strata in question; but the latter was not based on any fresh facts or observations. The author's own observations on the subject, carried on during many years, were detailed and illustrated by a map of the whole of the Taconic range. In conclusion, he pointed out that, even if Dr. Sterry Hunt's general principle were conceded, and he was not by any means himself prepared to make such a concession, it would have no bearing on the point at issue; for the supposed younger strata do not dip against the Taconic schists. In opposition to the view that the geological age of strata can be inferred from their mineral characters, he pointed out what remarkably different rocks have been produced by the metamorphism, in different degrees, of the strata of the Taconic range.—On some Nodular Felsites in the Bala Group of North Wales, by Prof. T. G. Bonney, F.R.S.—On the Cambrian (Sedgw.) and Silurian rocks of Scandinavia, by J. E. Marr, B.A., F.G.S. The author has examined the following areas of Cambrian and Silurian rocks in Scandinavia:—(1) Dalecarlia, (2) Ostrogothia and Westrogothia, (3) Christiania, (4) Scania, (5) Baltic Isles. A sketch of the stratigraphy of each of these regions was given, and the author gave the following conclusions:—

| | | |
|---|---|---|
| Silurian. | Mudstones of Ramsåsa and Bjersjölagård | = Ludlow. |
| | *Cardiola* beds: *Cyrtograptus* and *Retiolites* Shales ... ... ... ... ... ... ... | = Wenlock. |
| | *Lobiferus* Shales: Upper part of Brachiopod beds ... ... ... ... ... ... ... | = May Hill |
| Cambrian. | Lower part of Brachiopod beds ... ... | = Upper Bala. |
| | *Trinucleus* Shales: *Beyrichii* Limestone ... | = Middle Bala. |
| | Kärgårde Shales: Cystidean Limestone ... | = Lower Bala. |
| | &c. | = &c. |

A correlation with the beds of Bohemia was also given. The author pointed out that there is evidence of a physical break, varying in amount, as well as of a palæontological one between the Cambrian and Silurian of Scandinavia. Several of the beds of Scandinavia admit of a very exact parallel with strata in the English Lake district. The author considered that the fauna of these Scandinavian deposits affords evidence of migrations. This can be shown by observing that the same forms occur in two beds of different age, but are absent from an intermediate one: or by tracing beds laterally, and showing that the forms occur in an earlier deposit in one locality than in another. The author considered the black shales deep-water deposits, and accounted

for their wide extent by supposing the material derived directly from the decomposition of the felspar in metamorphic rocks, and so in a very fine state of division. The deep-water fauna in the Cambrian appears to have migrated from the south-west; the shallow-water forms, as might be expected, were more variable n their direction of migration: examples were given in support of this view. In Silurian times the direction of migration appears to have changed, the dispersal taking place from Britain, owing probably to greater local upheaval there. The coast-line also, instead of running in a west-north-west and east-south-east direction, seems to have run more west-south-west to east-north-east, as shallow-water forms are common in Britain, but deep-water forms in the central Swedish area. The result of the author's investigations, as bearing on classification, is that there is a break in Scandinavia at the base of the equivalents of the May Hill series, but no other break in the Cambrian series of Sedgwick of equal importance: no break, physical or palæontological, existing at the base of the *Ceratopyge*-limestone (Tremadoc), where some authors have drawn a boundary.

**Zoological Society**, April 18.—Prof. W. H. Flower, LL.D., F.R.S., president, in the chair.—Prof. Flower read a paper upon the mutual affinities of the animals composing the order Edentata, in which the usual binary division into *Phyllophaga* (or *Tardigrada*) and *Entomophaga* (or *Vermilingua*) was shown not to agree with the most important structural characters. These, according to the interpretation put upon them by the author, indicate that the *Bradypodidæ* and *Megatheriidæ* are allied to the *Myrmecophagidæ*, and also, though less closely, to the *Dasypodidæ*—all the American forms thus constituting one primary division of the order, from which both the *Manidæ* and *Orycteropodidæ* of the Old World are totally distinct.—A communication was read from Mr. Charles Darwin, F.R.S., introducing a paper by Dr. Van Dyck, of Beyrout, on the modification of a race of Syrian street dogs by means of natural selection.—Mr. Oldfield Thomas read an account of a small collection of mammals made by Mr. A. Forrer in the State of Durango, Central Mexico, in which examples of several northern forms, not hitherto recorded so far south, and several southern forms not hitherto known so far north, occurred.—A communication was read from Mr. Edward Bartlett, containing notes on a collection of mammals and birds formed by Mr. J. Hauxwell, in the neighbourhood of Nauta, Elvira, and Loretoyacu, on the Peruvian Amazons. The collection contained examples of new species of *Thamnophilus* and of *Crypturus*, which were proposed to be called *T. loretoyacuensis* and *C. balstoni*.—A communication was read from Mr. Edgar A. Smith, containing an account of the collections of terre-trial and fluviatile Mollusca lately made in Madagascar by Mr. W. Johnson and the Rev. W. Deans Cowan. Various new and interesting species of the genera *Cyclostoma*, *Vitrina*, *Helix*, *Stenogyra*, *Melanatria*, *Cleopatra*, *Ampulliaria*, *Limnæa*, *Physa*, *Planorbis*, *Corbicula*, and *Pisidium* were described.

**Meteorological Society**, April 19.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—C. P. Bolton, J. Dale, Capt. G. Gaye, T. T. Marks, G. Neame, A. F. Osler, F.R.S., and Miss E. I. Pogson were balloted for, and duly elected Fellows of the Society.—The papers read were:—Barometric gradients—wind velocity and direction at the Kew Observatory, by G. M. Whipple, B.Sc., F.R.A.S., F.M.S., and T. W. Baker, F.M.S. For the purpose of investigating the subject of the relation of the force and direction of the wind to the distribution of baro etric pressure, the authors have discussed the Kew observations for the five years 1875-79. The results show that the rate at which the wind blows increases almost directly with the inclination of the gradient in an arithmetical proportion, the mean rate of increase being 1·85 mile per hour for each additional ·0025 inch of difference in the barometer readings at each end of the slope. The authors find that the angle at which the wind crosses the line of gradient at Kew does not vary with either the steepness of the gradient or the velocity of the wind to any material extent, and also that the angle is found generally to lie between 40° and 60°, the average of the whole series of observations giving a deviation of 52°—On difference of temperature with elevation, by Gerard Dines, F.M.S. In this paper the author gives a summary of his observations made at Walton on-Thames during the last six years. Two stands, almost identical in size and construction, were used, one being placed on the ground, and the other on the top of the tower of the house, the bulbs of the thermometers in the former being four feet, and in the latter fifty feet above the ground. The results show that the average maximum temperature for every month is always greater, and the average minimum lower, on the ground than that on the tower.

**Chemical Society**, April 20.—Dr. Gilbert, president, in the chair.—The following papers were read:—On the atomic volume of iodine by Dr. Ramsay. The mean value obtained was 36·69. —On molecular volumes, by Dr. Ramsay. The author contrasts the relative probabilities of the antagonistic theories of Kopp and Schröder, and concludes that Schröder's hypothesis is untenable. The author has also determined the molecular volume of the group $CH_2$ at various pressures, and concludes that its value is less constant the higher the pressure; thus at 20 mm. pressure it varies from 17 to 21, at 30 atmospheres from 26·1 to 54·3.—On the action of acetone on phenanthraquinone, both alone and in the preseece of ammonia, by Dr. F. R. Japp and F. W. Streatfield. A white crystalline substance is formed, $C_{17}H_{15}NO_2$, which melts with decomposition about 230°, and when dissolved in strong hydrochloric acid and diluted with much water, forms a crystalline substance, $C_{17}H_{14}O_3$, melting at 90°. By heating phenanthraquinone and acetone in sealed tubes to 200° this substance $C_{17}H_{14}O_3$ is also formed, and by passing ammonia through its ethereal solution the substance first described $C_{17}H_{15}NO_2$ can be prepared.—A study of some of the earth metals contained in samarskite, by H. E. Roscoe. The author has obtained, by cry tallising a mixture of formiates of terbia and yttria, rhombic crystals exactly resembling the so-called formiate of philippium. This supposed new metal, philippium, has therefore no existence.—On the spectrum of terbium, by H. E. Roscoe and A. Schuster.—On the action of thiophosphoryl chloride upon silver nitrate, by T. E. Thorpe and S. Dyson. The authors hoped to obtain a mixed anhydride resembling nitric anhydride in which some of the oxygen was replaced by sulphur, but no such substance was formed.—On the action of potassium amalgam, sulphuretted hydrogen, and potassic hydrate respectively on tetra- and pentathionate of potassium, by V. Lewes. Potassium amalgam and tetrathionite form hypo ulphite, but if exce s of alkali be present, some sulphide is produced; pentathionates furnish similar products.—On the action of zinc, magnesium, and iron as reducing agents with acidulated solutions of ferric salts, by T. E. Thorpe. The conditions for maximum reduction in the case of zinc are: concentration of the ferric salt, a small amount of free acid, and a rather high temperature. Magnesium acts much less efficiently than zinc. With iron a rise of temperature apparently decreases the reducing action.

**Anthropological Institute**, April 4.—Major-General Pitt-Rivers, F.R.S., president, in the chair.—The election of Everard F. im Thurn was announced.—The president exhibited a series of carvings and painted masks from New Ireland.—A paper on the Papuans and Polynesians was read by Mr. C. Staniland Wake, who, from a consideration of the physical peculiarities of the Oceanic Races, arrived at the following conclusions:—1. The Eastern Archipelago was at a very early period inhabited by a straight-haired race belonging to the so-called Caucasian stock, the present modern representatives of which are the Australians. 2. To this race belonged also ancestors of all the Oceanic races, including the Papuans, the Melanesians, the Micronesians, the Tasmanians, and the Polynesians, as shown by their common possession of certain physical characters. 3. The special peculiarities of the several dark races are due to the introduction of various foreign elements, the Negritos having influenced all of them in varying degrees. 4. The lighter Oceanic races show traces of the Negrito influence, but they have been affected at various periods by intermixture with peoples from the Asiatic area, giving rise on the one hand to the so-called "savage Malays," and on the other hand to the Polynesians, who have been specially affected by the Malays. 5. Traces of an Arab or Semitic element are apparent among both the dark and the light Oceanic races, but chiefly among the Papuans and Melanesians, the former of whom may also possibly possess a Hindoo admixture. Mr. C. Pfoundes read a paper on "Rites and Customs in Old Japan," and exhibited a number of photographs and Japanese books and pictures.

**Entomological Society**, April 5.—Mr. H. T. Stainton, F.R.S., president, in the chair.—Exhibitions: A box of *Hymenoptera*, mounted on glass, by Mr. J. R. Billups; a remarkable *Coccinella*, intermediate between *C. oblongoguttata* and

*ocellata*, by Rev. H. S. Gorham; and a very complete collection of British *Trichoptera*, by Mr. R. McLachlan.—Mr. A. G. Butler communicated a continuation of his Heterocerous *Lepidoptera*, collected in Chili by Mr. T. Edmonds, in which forty-five species of *Noctuæ* were noticed.

**Victoria (Philosophical) Institute**, April 17.—Dr. Wallich delivered a lecture describing the results of his investigations during the last twenty-two years into the question of the origin of life, his studies having led him to go over the ground that Prof. Haeckel has investigated.

BERLIN

**Physiological Society**, April 17.—M. du Bois-Reymond, president.—Dr. Schiffer lectured about the effects of guachamaka-poison. An extract was made from the wood of the poisonous plant, which, like curare, is soluble in water and alcohol, and gives the general reactions of an alkaloid. The effects of the extract were tried on frogs, pigeons, and rabbits. A latent period of about fifteen minutes was always noticed. This was followed by a loss of vital and motor powers, although the activity of the heart and of the organs of respiration was not impaired. When small doses were given, the animals recovered after a few days; when large doses were given, the impairment of their powers ended in producing death. The muscles could be stimulated directly, but not indirectly, through the medium of the nerves. The guachamaka-poison had, consequently, exactly the same effects as curare. The circumstance that both these poisons must be administered in 25 times as large quantities, when given by the mouth, than when administered hypodermically, gave origin to some attempts to discover the reason of this difference. It was determined that these poisons are neither very rapidly thrown out of the system in the urine, when they have been absorbed, nor are there substances present in the alimentary canal, which decompose them. The probable cause of the difference is, that these poisons are with difficulty absorbed from the stomach.—Dr. v. Ott read a communication about the formation of nutritive albumen in the digestive canal. A frog's heart, which had been rendered pulseless by washing it out with salt solution, and which commences to beat again under action of nutritive (*i.e.* serum) albumen, was used as a reagent, in order to recognise the presence of this albumen. Peptone had no action on the pulseless frog's heart, but the contents of the intestinal tube of a dog, who had been fed on albuminous food-stuffs, had; consequently, serum-albumen must have been formed.—Prof. Adamkiewicz, of Krakau, gave a description of the anatomical alterations in a case of incipient tabes, and a description of the blood-vessels in the spinal cord, which form a very close capillary network. He believes that he can trace back tabes to a disease of the capillary vessels of the spinal cord.

PARIS

**Academy of Sciences**, April 17.—M. Jamin in the chair.—The following papers were read:—On the transformation of oxysulphide of carbon into ordinary and sulphurated ureas, by M. Berthelot.—Conservation of the hand by removal of bones of the carpus and radio-carpian resection, by M. Ollier. He has so operated in fifteen cases, and, after the first four, with very satisfactory results; the patients being able to use the hand in a light way, and several to do hard work with it.—Report on the photographic description of the Alps, by M. Civiale. This great enterprise is warmly eulogised by the Commission. M. Civiale selected forty-one panoramic centres, where he operated both as geodesian and photographer. In some cases he had to climb with his apparatus more than 3000 metres. At each station the apparatus was directed in fourteen equidistant azimuths, and the photographs were joined together. M. Civiale devotes 600 separate plates to details of the Alps, photographed at as many secondary stations. Full descriptions, containing much to interest the engineer and ordinary traveller, are given in his journal.—On quarantines at Suez, by M. Fauvel. He reviews at some length the prophylactic measures taken in recent years. M. de Lesseps seems to have been inadequately informed; what he proposes is exactly (M. Fauvel says) the *ordinary* practice at Suez; facilities as great as possible where the ship from a distance is really healthy; serious measures against every infected ship, or ship suspected of being so.—Method of observation of meteors at the summit of the Puy de Dôme, by M. Alluard. A circular terrace with balustrade has been formed round the tower; the balustrade is divided into 360° (N. 0°, E. 90°, &c.) and the localities all round are referred to this graduation. Two terrestrial telescopes are supported on chariots running on rails round the terrace. Geographical maps are constructed, having concentric circumferences round the Puy de Dôme and radii from it. The origin and course of any meteor (thunderstorm, mist, &c.) is easily and exactly observed.—On spermatogenesis in plagiostones and in amphibians, by M. Sabatier.—The death of M. Giffard was referred to.—Observations of planets 221, 222, 223, and 224, and of comet *a* 1882 (Wells) at Paris Observatory, by M. Bigourdan.—Elements and ephemerides of comet *a* 1882 (Wells) by the same.—Observations at Marseilles Observatory, by M. Coggia.—On the theory of uniform functions of a variable, by M. Mittag-Leffler.—On a property of the circle, by M. Darboux.—On a passage of the "Mecanique analytique," relative to the principle of the least action, by M. Brassinne.—On pernitric acid, by MM. Hautefeuille and Chappuis. On formation of pernitric acid by electrisation of dry air, when the maximum tension for a given temperature has been reached, the electric discharges decompose the acid suddenly into hyponitric acid and oxygen (shown by sudden fall of pressure, and an intense red colour). A retrogration of ozone takes place simultaneously, through heat liberated in decomposition of the acid. In presence of certain proportions of hyponitric acid neither ozone nor pernitric acid can be re-formed. To get as much pernitric acid as possible, one should operate at a low temperature; (other conditions are indicated).—On some reactions of salts of protoxide tin, by M. Ditte.—Action of ammoniac gas on nitrate of ammonia, by M. Raoult.—On the discovery of alkaloids derived from proteic animal matters, by M. Gautier. In 1873 he observed and announced that putrefaction of albuminoid matters gave rise to true fixed and volatile alkalies; (Selmi later).—On tetranitrated bromide of ethylene, by M. Villiers.—On the origin of saccharine matters in the plant, by M. Perrey. Cane-sugar is a product of direct elaboration of the green cells. Glucose, never found in the plant without saccharine, is probably derived from the latter by hydration. A reaction between saccharose and glucose, secondary in the leaf, primary in the seed, produces starch. In germination starch is transformed into dextrine and glucose. In normal nutrition saccharose appears with an essential *rôle*.—On the Echinida of the Senonian strata of Algeria, by M. Cotteau.—On the brain of *Arctocyon Ducilii* and of *Pleuraspidotherium Aumonieri*, mammalia of the lower eocene of the environs of Rheims, by M. Lemoine.—A "Traité d'Hydrographie," by M. Germain, was presented; also a volume by M. Pochet, entitled "Theory of the motion in curves on railways, with its applications to way and material; new method of ensuring the perfect working of axles in curves." M. Pochet expresses a hope that the State, which is about to construct no less than 14,000 to 15,000 km. of new lines within a few years, may take the initiative in fixing at the outset the elements of the typical railway, and that his theory may be of service for this.

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